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SUPERCRITICAL CARBON DIOXIDE INTERACTION WITH POLYMERIC MATERIALS: DESORPTION DIFFUSION COEFFICIENT MEASUREMENTS



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14. ABSTRACT Chemical-polymer compatibility is an important criterion in the development of solvent-based extraction and cleaning systems for removal of toxic contaminants from polymeric surfaces. The potential degradation of polymer properties and performance is especially critical for sensitive equipment cleaning, decontamination, and extraction. The candidate cleaning fluids for sensitive equipment include fluorocarbons and supercritical fluids. An overall material evaluation strategy has been developed for evaluating the degradation of polymer properties by exposure to supercritical fluids. The initial evaluation involves the measurement of the sorption and desorption diffusion coefficients in a spectrum of polymer compositions. The objective was to characterize the complete desorption process by the continuous measurement of the entire diffusion process. Another purpose of diffusion coefficient measurements was to provide an estimate of the time required for each material to completely desorb all of the carbon dioxide cleaning fluid and return the material to the original unplasticized condition. These measurements and calculations provided the high data density required to calculate a low concentration Fick's Law diffusion coefficient and equation for the extrapolations. The composition spectrum selected contains hydrogen bond donor, hydrogen bond acceptor, dipolar, and non-polar polymer structures. Over 20 thermoplastics and elastomers were studied with supercritical carbon dioxide.																	
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PREFACE

The work described in this report was authorized under Project No. 0603384BP. The work was started in October 1990 and completed in May 2002.

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CONTENTS

1.	INTRODUCTION	7
2.	EXPERIMENTATION	8
2.1	Extraction Instrumentation.....	8
2.2	Desorption Instrumentation.....	9
2.3	Chemicals and Materials	9
2.4	Procedures	11
2.4.1	Supercritical Exposure Procedures	11
2.4.2	Sorption Procedures	12
2.4.3	Desorption Procedures	12
2.4.4	Kinetic Analysis Data Reduction Procedures	12
3.	RESULTS	16
3.1	Supercritical Carbon Dioxide Sorption and Desorption Data for Polymeric Materials.....	16
3.2	Sorption Values Corrected for Fraction Extracted Employing Equilibrium Desorption Measurements.....	17
3.3	Comparison of Sorption Values with Correction to Zero-time Mass Based on High Concentration Desorption Extrapolations	19
3.4	Time for Complete Desorption and Reuse of Sensitive Equipment after Exposure Employing Fick's Law Low Concentration Diffusion Equations	21
3.5	Indentation Hardness.....	25
4.	DISCUSSION	25
5.	CONCLUSIONS.....	27
	LITERATURE CITED	29
	BIBLIOGRAPHY	31
	APPENDIXES	
	A – COMPUTERIZED PROCEDURES	33
	B – DESORPTION DIFFUSION COEFFICIENT DATA SETS AND COMPUTATIONS	37

FIGURES

1.	Desorption Diffusion of Supercritical Carbon Dioxide from Polymeric Materials: PSB	17
2.	Desorption Diffusion of Supercritical Carbon Dioxide from Polymeric Materials: PIP	19
3.	Fick's Law Plot of Desorption Diffusion of Supercritical Carbon Dioxide from Polymeric Materials: PIB	20
4.	Fick's Law Plot of Desorption Diffusion of Supercritical Carbon Dioxide from Polymeric Materials: SMO	22

TABLES

1.	Supercritical Fluid Cell Dimensions and Volume for Extraction Equipment of Several Different Capacities	8
2.	Experimental Conditions and Specifications Employed for the Desorption Diffusion Coefficient Determination	10
3.	Carbon Dioxide Sources for Supercritical Experimentation	10
4.	Sources of the Material Specimens Employed in Desorption Experimentation	10
5.	Polymeric Compositions Employed in Supercritical Carbon Dioxide Interaction Experiments	11
6.	Comparison of Experimental Conditions for Supercritical Carbon Dioxide Sorption in Polymeric Materials: Measurement Conditions versus Similar Literature Conditions	12
7.	Procedures for Supercritical Sorption of Polymeric Materials	13
8.	Procedures for Desorption Diffusion Coefficient Determination by Thermogravimetric Instrumentation	13
9.	Kinetic Data Analysis Procedures for Desorption Diffusion Coefficient Calculations	14
10.	Equations Employed for Sorption and Desorption Diffusion Data Reduction and Analysis	15
11.	Supercritical Carbon Dioxide Sorption into Polymeric Materials Based on Correction for Fraction Extracted: Conditions of 1400 psig and 50 °C after 15 min	18
12.	Comparison of Sorption Corrected for Extrapolation to Zero-time at the end of the Decompression Period Versus Uncorrected Sorption after 7-12 min and 20 min	21
13.	Time for the Complete Desorption of all Carbon Dioxide from Polymeric Materials Based on a Fick's Law Extrapolation of Low Concentration Desorption Diffusion	23
14.	Number of Polymeric Materials in Various Cases Based on Desorption Relative to the Baseline and a Decrease or Plateau Approaching the Baseline	23
15.	Indentation Hardness Changes to Polymeric Materials after Exposure to Supercritical Carbon Dioxide, Followed by Complete Desorption: Exposed to 1400 psig at 50 °C for 15 min	26

SUPERCritical CARBON DIOXIDE INTERACTION WITH POLYMERIC MATERIALS: DESORPTION DIFFUSION COEFFICIENT MEASUREMENTS

1. INTRODUCTION

Chemical-material compatibility is a critical criterion in development of a decontamination system. The degradation of material properties and performance is especially important for sensitive equipment cleaning and decontamination. Sensitive equipment includes electronics, optics, and other high-value and unique equipment. The candidate cleaning fluids for sensitive equipment include supercritical carbon dioxide and fluorocarbons.

The overall material evaluation methodology for compatibility with decontaminants is under development.¹⁻³ The selection of representative materials for compatibility testing is underway based on several parallel approaches. These include a top-down, materiel-to-material analysis that identifies surface materials in a spectrum of high-cost equipment. Several material science based approaches were also applied to identify a spectrum of material physical states, molecular structures, and hydrogen bond and polarity classes.⁴

The initial evaluation in any chemical-material evaluation test scheme usually involves measurement of sorption or solubility of the candidate cleaning fluid in a spectrum of relevant material compositions. This methodology can also be applied to the desorption measurements of the contaminants by a thermal decontamination process or by solvent system based decontaminants, such as Decon Green. The desorption diffusion methodology developed is also applicable to investigations on the environmental fate of hazardous chemicals on material surfaces in wind tunnel experiments. The supercritical carbon dioxide processing conditions and material sorption experimentation are being reported separately. The experimentation reported herein concentrates on the desorption diffusion kinetic process for supercritical carbon dioxide from polymeric materials.⁵

The purpose is to characterize the complete desorption diffusion process by continuous measurement of the entire diffusion curve, with the exception of a few minute time increment at the start of the experiment and a few percent of the final weight-loss. The next purpose was to use the continuous desorption curve to provide an accurate extrapolation of the zero-time sorption value immediately after supercritical carbon dioxide decompression. This extrapolation from the high concentration region of the desorption curve allowed calculation of a corrected sorption value for each material that provided an accurate ranking of material solubility relative to the uncorrected values. The characterization of the plateau to equilibrium desorption allowed the measurement of extractables and, therefore, the correction of the sorption value for this fraction extracted. Another purpose of diffusion coefficient measurements was to provide an estimate of the time required for each material to completely desorb all of the carbon dioxide cleaning fluid and return the material to the original unplasticized condition. These measurements and calculations provide an estimated 'time before reuse' after the decontamination process. The continuous measurement of desorption provided the high data density required to calculate a low concentration Fick's Law diffusion coefficient and equation

for the extrapolation to initial material sample weight before exposure. The experimental strategy includes mechanical, optical, thermal, and electrical property characterization to measure the influence of the sorbed decontaminant. In this initial screening stage, indentation hardness measurements of surface mechanical properties were completed.

2. EXPERIMENTATION

2.1 Extraction Instrumentation.

The extraction instruments and cells employed to expose the materials to supercritical carbon dioxide are listed in Table 1. The instrument cell nomenclature, dimensions, and volume are provided in the first four columns. The dimensions refer to the useable space for material specimens. The fifth column lists the type of test performed with specimens exposed in the various cell sizes. In general, the diffusion specimens were relatively small; therefore, the smaller cell sizes were employed.

Table 1. Supercritical Fluid Cell Dimensions and Volume for Extraction Equipment of Several Different Capacities

Cell	Equipment	Dimensions (cm): diameter x length	Volume (mL)	Test Specimen	Materials: Cell with Specimen Packing
1	Hewlett Packard Cartridge (07680-61370) for HP7680T	1 x 7	5.5	Desorption	Stainless steel with Whatman GF/A 90mm glass microfibre filter
2	Applied Separations Cell for Applied Separations SCF Extractor	1.3 x 15	24	Desorption, Flex, DMA	Stainless steel with Applied Separations Polypropylene Wool
3	Thar Designs Cell for Applied Separations SCF Extractor	3 x 23	140	Tensile, thermoplastics	Stainless steel
4	Thar Designs Cell for Applied Separations SCF Extractor	5.3 x 15	350	Tensile, elastomers	Stainless steel
5	Vessel for CF Technologies Extractor	17 x 43 basket	6500	Tensile, others	Stainless steel

2.2 Desorption Instrumentation.

A Mettler Model AT261 (Toledo, OH) macrobalance balance was used for correlation of specimen weights with the microbalance and provided reproducibility of 0.015 mg and readability of 0.01 mg. A New Age Industries Model Exacta EX200/300 Series instrument (New Age Industries Inc., Willow Grove, PA) was used for the indentation hardness measurements.

The thermogravimetric instruments employed to measure the continuous desorption of sorbed supercritical carbon dioxide were a TA Model TGA 2950 and Model TGA 951 (TA Instruments Inc., New Castle, DE). The final values reported were all measured with a combination of the Model TGA 2950 and control software Version 8.10B (2.3A).

Custom specimen holders were required for the unique research measurements and were constructed to clamp the ca. 1-cm diameter disk shaped specimens, allowing free surface diffusion on all sides. The 0.62-0.64 mm diameter nichrome wire was formed to a shape that matched the TGA Model 2950 hang down wire hook, cleared the furnace sides, and avoided buoyancy fluctuations.

The experimental conditions employed in the desorption measurement process are recorded in Table 2. The microbalance performance depends on the range and capacity used in the experiment, and these are listed in the first three rows of the table. The resolution and accuracy of the desorption measurements are listed next, based on the microbalance specifications for the range employed. The data acquisition rate of 6 points/min was more than adequate for the slow desorption process. Slower rates were employed for data segments near the plateau region, as noted in the data set documentation. The desorption temperature of 30 °C was selected to provide a temperature near environmental temperatures that could be effectively controlled due to the offset from ambient temperatures of near 25 °C. The flow rate setting was high enough to avoid back condensation and avoided buoyancy effects. The pre-equilibration time was the time required to equilibrate the specimen chamber at 30° so there was a minimum loss of temperature during the 2 min required to open the furnace, load the specimen, and close the furnace. A temperature-programmed ramp to 30° minimized temperature overshoot as the furnace chamber re-equilibrated at 30° after the specimen was mounted on the wired holder within the chamber.

2.3 Chemicals and Materials.

The supercritical carbon dioxide and polymeric materials used are documented in Tables 3-5.

Several categories of material samples were studied in the initial experimentation. One category was based on a survey of materials in sensitive equipment. Another category included thermoplastics tested in previous supercritical carbon dioxide studies to compare the reproducibility of the material sorption process in our laboratory with published data sets. The exact samples employed by others could not be obtained; therefore, better-documented analogs were procured from other sources. Another set of materials was selected from a set of reference materials developed for chemical defense testing. The polymer compositions were those from chemical defense protective equipment that would be brought to and worn at contaminated

sensitive equipment decontamination sites. Materials used in protective masks and gloves were emphasized. The material sources, the codes used to label the material samples, and the source addresses are listed in Table 4. Each material sample source is documented in other tables based on these codes. The itemized sample number is listed, followed by the complete nomenclature, the code, the thickness, and the company source code (see Table 5). Some of the materials in Table 5 were only employed in sorption screening experiments, and detailed desorption diffusion coefficient measurements were not performed on these materials. The subset of the materials with diffusion measurement values are highlighted in Table 5, and the data are listed in the tables in the results section.

Table 2. Experimental Conditions and Specifications Employed for the Desorption Diffusion Coefficient Determination

Variable	Value
Range	0.1 µg to 100 mg
Capacity, total load	5 g
Capacity, weighing	1.0 g
Resolution	0.1 µg
Accuracy	+ 0.1%
Data Acquisition rate	6 points/min for the 1 st 24 hr; 1 point/min after 24 hr
Temperature, °C	30.00
Flow rate, cc/min	100 (60 + 40)
Pre-equilibration time	> 2 min
Temperature programmed ramp to isothermal	2°/min

Table 3. Carbon Dioxide Sources for Supercritical Experimentation

Instrument	Applied Separations SCG Extractor	Hewlett Packard 7680T
Grade	"Bone-dry"	Supercritical Fluid Extraction, SFE
Purity, %	99.8 minimum	99.99 minimum
Valve	CGA 320	CGA 320
Source	Roberts Oxygen Co., Rockville, MD 20855	BOC Gases, Rivertown, NJ

Table 4. Sources of the Material Specimens Employed in Desorption Experimentation

Material Source	Code	Address
Goodfellow, Inc.	GF	800 Lancaster Ave; Berwyn, PA 19312-1780; (800) 821-2870
Harbor City Plastics	HC	1306 Governor Court; Abingdon, MD 21009
Smithers Scientific Corp.	SS	Smithers Scientific Services, Inc.; 425 West Market Street, Akron, OH 44303-2099; (330) 762-7441 Fax: (330) 762-7447
Resin Kit	RK	1112 River St; POB 509; Woonsocket, RI 02895-0509

Table 5. Polymeric Compositions Employed in Supercritical Carbon Dioxide Interaction Experiments

No.	Polymer Name	Polymer	Nominal Thickness mils	Source Code
1.	Polyethylene, High Density	HDPE		GF
2.	Polyethylene, High MW	HMWPE		GF
3.	Polyethylene, Low Density	LDPE		GF
4.	Polyethylene-propylene	PEP	49	GF
5.	Polytetrafluoroethylene	PTFE		GF
6.	Poly(0.9-styrene-co-0.1-butadiene) Polysar 3350, high impact	PSB	75	GF
7.	Polyvinylidene fluoride, Kynar	PVDF		GF
8.	Polyvinylchloride, unplasticized	UPVC		GF
9.	Polysulfone Thermalux	PSF		GF
10.	Polyvinylchloride, plasticized	PVC	41	HC
11.	Poly(2,6-dimethyleneoxide) Noryl	PPO	34	HC
12.	Polycarbonate Lexan	PC	35	HC
13.	Polymethylmethacrylate Plexiglas	PMMA	39	HC
14.	Acrylonitrile butadiene styrene (20-8-72%) Royalite	ABS	62	GF
15.	Poly(imide) film	PIF	11	GF
16.	Polyetheretherketone	PEEK	20	GF
17.	Polyurethane	PU	42	GF
18.	Poly(oxymethylene) Delrin	POM		GF
19.	Polyethylene terephthalate Mylar	PET		GF
20.	Cellulose -OH acetate butyrate Uvex	CAB		GF
21.	Polyethylene terephthalate glycol, Vivak	PETG		GF
22.	Polyetherimide Ultem	PEI		GF
23.	Polyamide Nylon66	PA		GF
24.	Poly(isoprene) Natural Rubber	PIP	41	SS
25.	Poly(isobutylene) Butyl Rubber	PIB	41	SS
26.	Poly(bromobutylene) Bromobutyl Rubber	PBB	42	SS
27.	Poly(dimethylsiloxane)	PDMS	47	SS
28.	Silicone Modified Organic polymer (proprietary)	SMO	75	proprietary
29.	Poly(styrene-butadiene) rubber	PSBR	41	RK
30.	Poly(tetrafluoroethylenepropylene) Aflas	PTFEP	38	SS

2.4 Procedures.

2.4.1 Supercritical Exposure Procedures.

The supercritical exposure procedures and conditions employed were based on conditions that were found to successfully remove contaminants from non-sorptive surfaces in previous exploratory experiments (B. MacIver, D. Sorrick; SBCCOM). The supercritical conditions are documented in Table 6. The extraction equipment and cells are documented earlier in this document (see Section 2.1).

Table 6. Comparison of Experimental Conditions for Supercritical Carbon Dioxide Sorption in Polymeric Materials: Measurement Conditions versus Similar Literature⁶⁻⁸ Conditions

Experimental Conditions	Units	RT#1	RT#2	Literature C3
Pressure	Psig.	1399	1399	2000
Temperature	°, C	50	50	40
Time: Static Extraction @ PT	Min	15	15	60
Time: Decompression	Min	1	1	60
Time: 1 st Sorption Weighing	Min	5	20	20

The first column in Table 6 lists the supercritical pressure, temperature, and exposure-time conditions. The second column documents the units. The remaining columns define codes that document the set of experimental conditions in the table. These codes are used in experimental data sheets and computer data file documentation. The difference in RT#1 and RT#2 is only the sorption weighing time; this weighing time at 20 min allows a direct comparison with literature (last column) that reported the first weighing at 20 min.

The extraction time refers to a static exposure without flow through the cell. The decompression time is a rapid but controlled pressure drop to ambient at an approximately linear rate. The "Sorption Weighing" time defines the time lag required to disassemble the cell and manipulate the material specimen to obtain the initial weight. Carbon dioxide desorption under ambient conditions occurred during this lag and can be corrected by an extrapolation back to the end of the decompression period.

2.4.2 Sorption Procedures.

The procedures for exposing the material samples to the supercritical extraction and cleaning process have been documented separately; therefore, these procedures are briefly surveyed in Table 7.

2.4.3 Desorption Procedures.

The procedures for the desorption measurement involve an interleaving of specimen manipulation with software control steps, therefore, these are documented in detail in the Appendix A. A general survey is provided in Table 8.

2.4.4 Kinetic Analysis Data Reduction Procedures.

The basic data sets consisted of time, temperature, and weight measurements. These files were processed by various filtering techniques and data conversions to Fickian parameters. Interim results were processed with custom C++ code based on our previous operational computational methods. A general description of the kinetic data analysis procedure is provided in Table 9. The final computations were performed using custom coded Excel functions, and the documentation is provided in Table 10.

Table 7. Procedures for Supercritical Sorption of Polymeric Materials

Thermoplastic and elastomer sheet specimens were stamped out using 3/8-inch (or other size) hollow punch set (SE Corp.)
Thermoplastic molded specimens were used "as is".
Specimens were pre-weighed, labeled and placed in individual containers.
A set of 3-6 specimens was loaded into a supercritical cell with separation by Whatman GF/A 90mm glass microfibre filter packing sheets for desorption disk specimens and separation by Applied Sciences Polypropylene Wool for other specimen sizes.
Specimen identity was retained by a first-in/first-out sequencing.
Supercritical instrument controls were set for the instrument model employed.
A loaded cell was inserted or connected and the experiment was initiated.
A laboratory stopwatch was started at the end of the decompression step, when the specimen returned to atmospheric pressure.
The supercritical cell was rapidly disassembled in order to weigh the specimen within 4-5 min of the end of the decompression step.
The specimen weight and time after decompression were recorded in a hardcopy data capture version of the spreadsheet.
Specimens were submitted to post-exposure experimentation and the time after decompression was recorded from the stopwatch, for example, diffusion coefficient measurements by TGA (or potentially, for glass transition by DMTA or mechanical properties by Universal Test Machine).

Table 8. Procedures for Desorption Diffusion Coefficient Determination by Thermogravimetric Instrumentation

Standard calibration procedures were completed according to the operations manual
The pre-exposed specimen was weighed on the TGA at 30 °C, removed, and submitted for exposure.
The TGA was programmed to pre-equilibrate at 30° for at least 2 min.
All possible pre-experiment controls were set to minimize the time between loading the desorbing specimen and the start of data acquisition.
After the specimen was removed from the exposure cell, the TGA furnace was opened, the specimen mounted, the furnace closed, and data acquisition initiated.
Stopwatch time was recorded in the TGA remarks field to document the lag time between the end of decompression and the first desorption data point.
Real-time plotting was initiated to allow an estimation of the attainment of a plateau and the presence of extraction by the mass signal falling below the initial mass.
After a plateau was attained, the experiment was terminated, the specimen was transferred from the TGA microbalance to the macrobalance and comparative mass was recorded.
Macrobalance recordings were completed as needed to check for further desorption.
DMTA or other property measurements were performed as a function of specimen weight and desorption time (not reported herein).
Indentation hardness was measured after desorption was complete and compared with values measured on unexposed specimens from the same lot.

Table 9. Kinetic Data Analysis Procedures for Desorption Diffusion Coefficient Calculations

Material identification and the sorption and desorption conditions were stripped from the file headers into the data sheet formats.
Additional material and sorption/desorption experiment documentation were keyed into the data form.
Pre-exposure data and statistics were calculated by the code or internal instrument functions for the diameter, thickness, mass, and indentation hardness.
Exposure data and statistics were calculated: Exposure time, time lag, mean temperature with 95% confidence interval, sorption weight, sorption weight %, sorption weight corrected for extractables, sorption weight % corrected for extractables, indentation hardness with percent change.
Time-temperature-mass data sets were reduced to kinetic parameters by: converting units; converting mass to relative mass; converting lapsed time to absolute time after end-of-decompression; converting time to Fick's Law time ^(1/2) .
Converted data sets were regressed using a Fick's Law relation of Reduced-mass versus Time ^(1/2) over two regions: High Concentration Region and Low Concentration Region. The high concentration region in the desorption experiment contains the initial diffusion from the swollen polymer surface, not meeting Fick's Law criteria; the low concentration region contains the final diffusion from the depleted and unswollen polymer surface, meeting Fick's Law criteria.
The procedure for selecting the range for the high concentration region consisted of including the coordinate for zero-time and 1.0 Reduced Mass, the initial data acquisition point, then through to the inflection point for deviation from the linear regression fit, usually occurring over a reduced mass range of about 0.65 to 0.55.
The regression was fitted through a single initial zero-time versus 1.0 Reduced Mass coordinate on the y-axis and contained an initial region without data points due to the time lag between decompression and the start of the desorption data acquisition.
The procedure for selecting the range for the low concentration region consisted of including the coordinate for the last data acquisition point through to the inflection point for deviation from the linear regression fit, usually occurring over a reduced mass range of about 0.08 to 0.02.
The low concentration plateau was classified into one of three observed cases and appropriate data reduction procedures were applied for each case, as follows.
Case 1: The plateau occurred near the initial mass and therefore, the absolute and relative reduced masses were similar. The final mass was defined as the initial zero-time mass.
Case 2: The plateau occurred below the baseline for initial mass, indicating extraction had occurred. The last data point was assigned as the final mass for defining the total mass of liquid sorbed and desorbed.
Case 3: The plateau occurred significantly above the initial mass and could not be extrapolated to the initial mass axis in a reasonable time. The final mass was defined as the initial, zero-time mass. (This data reduction procedure ignores the possibility of a tare off-set, however, for the small differences observed between the plateau mass and initial mass, the effect on the results was small)
The low concentration diffusion coefficient equation was used to calculate the time to complete desorption.

Table 10. Equations Employed for Sorption and Desorption Diffusion Data Reduction and Analysis

Cell Number or Cell Range, EXCEL	Documentation
An: File transfer from instrument	Time, min
Bn: File transfer from instrument	Temp, degrees celcius
Cn: File transfer from instrument	TGA mass, mg
$Dn = (An * 60)$	Converting time in min (An) to time in seconds (Dn)
$En = (Dn + M4)$	Adjustment to time for extrapolation to "zero" time
$Fn = (En / 3600)$	Converting adjusted time in seconds (En) to hours (Fn)
$Gn = SQRT (En)$	Function for Fick's Law square root of time dependence: $En^{1/2} > Gn$ column
$Hn = (((Cn - K8) / K8) * 100)$	Converting mass remaining in milligrams to percent using the initial, dry sample mass as the reference mass
$In = ((Cn - K8) / (K4 - K8))$	Fractional mass desorbed: Column I created from Column C
$Jn = (1 - ((K4 - Cn) / (K4 - M8)))$	Fractional mass remaining: Column J created from Column C
K4: Cell transfer or from ANALIZ file	Extrapolated mass at zero time
K8: Keyed input or from ANALIZ file	TGA initial, dry mass
$K12 = PI() * POWER (((N20 * P20)/4),2)$	Computing High Concentration Diffusion Coefficient (HCDC)
K15: Cell transfer	R-Square for regression equation for HCDC calculation
$K18 = (-P19) / P20$	X-intercept for HCDC
K21: Cell transfer	Y-intercept for regression equation for HCDC calculation
$K25 = P19 * K4$	Converting y-intercept for HCDC into mass, mg.
$L4 = (((K4 - K8) / K8) * 100)$	Converting "zero" time mass to wt. %
L8: Cell transfer	Equilibrium mass of desorbed sample, at end of experiment
$L12 = PI() * POWER (((N20 * P43)/4),2)$	Computing Low Concentration Diffusion Coefficient (LCDC)
L15: Cell transfer	R-Square for regression equation for LCDC calculation
$L18 = (-P42) / P43$	X-intercept for LCDC
L21: Cell transfer	Y-intercept for regression equation for LCDC calculation
$L25 = (POWER (L18,2)) / 3600$	Converting x-intercept for LCDC into time, hrs.
M4: Keyed input or from ANALIZ file	Adjustment to account for elapsed time in seconds between sample exposure and start of experiment after sample loading
M8: Keyed input	Minimum mass used for LCDC calculation
M12: Cell transfer	Total mass of liquid sorbed
$M25 = (POWER (L18,2)) / 600$	Converting x-intercept for LCDC into time, min.

Table 10. Equations Employed for Sorption and Desorption Diffusion Data Reduction and Analysis (Continued)

Cell Number or Cell Range, EXCEL	Documentation
M29: Keyed input	Maximum TGA mass from original TGA data file
M33: Cell transfer	Mass of liquid sorbed based on maximum TGA mass in M29
$M37 = (M33/K8)/100$	Sorption, percent, based on maximum TGA mass in M29
$M41 = (((M37 - L4) / L4) * 100)$	Relative error, %, of initial 7-12 min sorption value
N4: Keyed input or from ANALIZ file	Shore hardness scale
N8: Keyed input or from ANALIZ file	Pre exposure hardness
N12: Keyed input or from ANALIZ file	Post desorption hardness at time
$N16 = (((N12 - N8) / N8) * 100)$	Change in hardness, %, after exposure and desorption
N20: Cell transfer	Mean thickness, cm.
N22: Copy-paste input	Original TGA data filename
N25: Cell transfer	X-intercept for LCDC as a time in min
N29: Keyed input	Adjusted TGA mass for 20 min elapsed time from exposure
N33: Cell transfer	Mass of liquid sorbed based on 20 min elapsed time in N29
$N37 = (N33/K8) * 100$	Sorption, %, based on N33
$N41 = (((N37 - L4) / L4) * 100)$	Relative error, %, of 20 min literature sorption value
P19: Cell transfer from regression cell	Y-Intercept Diffusion Coefficient from HCDC regression equation
P20: Cell transfer from regression cell	Slope from regression equation for HCDC calculation
P42: Cell transfer from regression cell	Y-intercept Diffusion Coefficient from LCDC regression equation
P43: Cell transfer from regression cell	Slope from regression equation for LCDC calculation

3. RESULTS

3.1 Supercritical Carbon Dioxide Sorption and Desorption Data for Polymeric Materials.

An example of a plot of time versus desorption diffusion mass loss is shown in Figure 1. In this example for poly(styrene-butadiene) (PSB) thermoplastic, the desorption process is well behaved, and the carbon dioxide loss plateau is approaching the zero-time baseline. The full compilation of data sets is provided in Appendix B. Subsets of the data are organized in tables in the following section to allow an evaluation of trends in the data as a function of experimental and data reduction techniques.

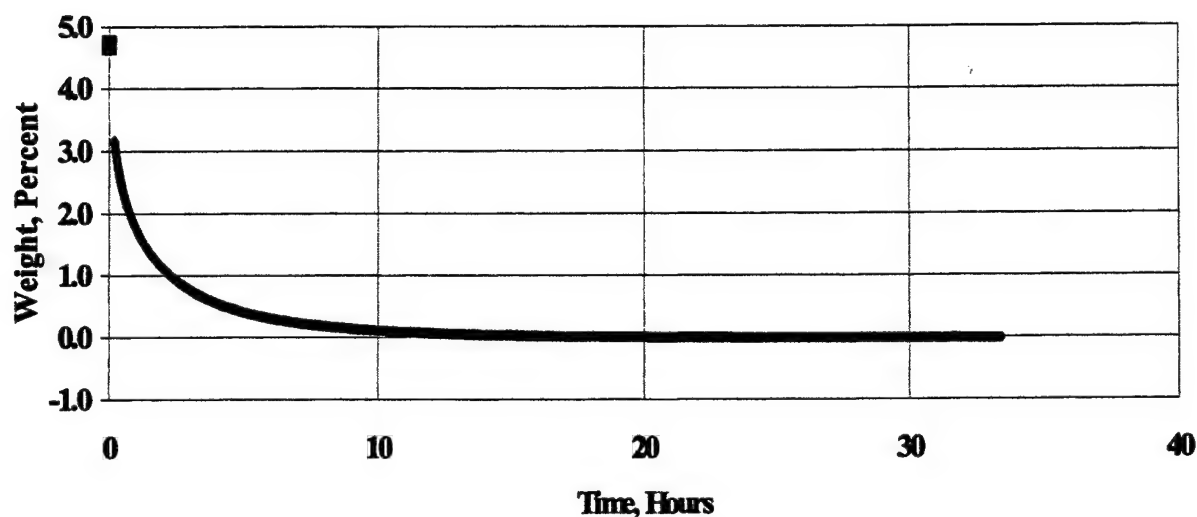


Figure 1. Desorption Diffusion (30 °C) of Supercritical Carbon Dioxide from Polymeric Materials: PSB (0140d)

3.2 Sorption Values Corrected for Fraction Extracted Employing Equilibrium Desorption Measurements.

The sorption results in Table 11 are corrected for the fraction of mobile additives in the material that were extracted during the supercritical exposure. Poly(isoprene), PIP in Figure 2, is an example of a polymer containing mobile additives that appear to be partially extracted; the carbon dioxide desorption plateau is below the original baseline providing a measurement of the fraction extracted. The positive 'Extracted, %' values in column 5, Table 11, denote the desorption diffusion data plateaued below the initial baseline and indicated a net extraction. The (+/-) sign convention is reversed in evaluating the raw mass data, because the mass values below the zero baseline are negative when net extraction takes place. The magnitude of the fraction extracted is programmed into the data reduction procedures to calculate the corrected sorption. The value for the corrected sorption, based on the fraction extracted (in the third column of the table), is followed by the uncorrected sorption value. The relative error due to ignoring the extractables is calculated in the last column. Note that experimentation that ignores the extraction of the additives in the material causes considerable error that would change the relative ranking of materials for resistance to supercritical carbon dioxide sorption. The 'Not Applicable' entry refers to materials in which there was no measurable extraction. The methodology was capable of ranking the relative sorption levels for the spectrum of materials. The corrected sorption value was required to correctly rank the materials. The general trend in supercritical carbon dioxide was slightly influenced by fraction extracted. For the combination of low sorption and high extractables (e.g., PEEK), the relative error was high but the ranking was only slightly influenced.

Table 11. Supercritical Carbon Dioxide Sorption (%) into Polymeric Materials Based on Correction for Fraction Extracted: Conditions of 1400 psig and 50 °C after 15 min

No.	Polymer Codes	Sorption, Corrected, %	Sorption, Uncorrected, %	Extracted, %	Relative Error, %
1.	PDMS, 139d	0.44	0.44	-0.03	Not Applicable
2.	PIF, 0151z	1.09	0.21	0.88	-80.7
3.	PVC, 0089d	1.47	1.47	-0.03	Not Applicable
4.	PEEK, 154z	1.49	1.20	0.28	-18.8
5.	PVC, 0110z	1.65	1.65	-0.02	Not Applicable
6.	PTFEP, 153z	2.39	2.24	0.15	-6.3
7.	PC, 0082d	2.46	2.36	0.10	-4.1
8.	PC, 0117d	2.62	2.49	0.13	-5.0
9.	PBB, 0138d	3.12	3.00	0.12	-3.8
10.	PEP, 0130d	3.22	3.11	0.11	-3.4
11.	PPO, 0091d	3.64	3.64	-0.24	Not Applicable
12.	ABS, 0115d	3.75	3.72	0.03	-0.8
13.	PIP, 0131d	4.12	3.39	0.73	-17.7
14.	PPO, 0096d	4.29	4.29	-0.17	Not Applicable
15.	PSB, 0140z	4.72	4.70	0.01	-0.2
16.	SMO, 0129d	4.94	4.94	-0.20	Not Applicable
17.	PMMA, 075z	5.83	5.83	-0.90	Not Applicable
18.	PMMA, 105z	6.24	6.24	-0.22	Not Applicable
19.	PU, 0124d	7.08	6.80	0.28	-4.0
20.	PSBR, 143z	7.32	6.58	0.74	-10.1
21.	PIB, 0137d	7.88	7.88	-0.13	Not Applicable

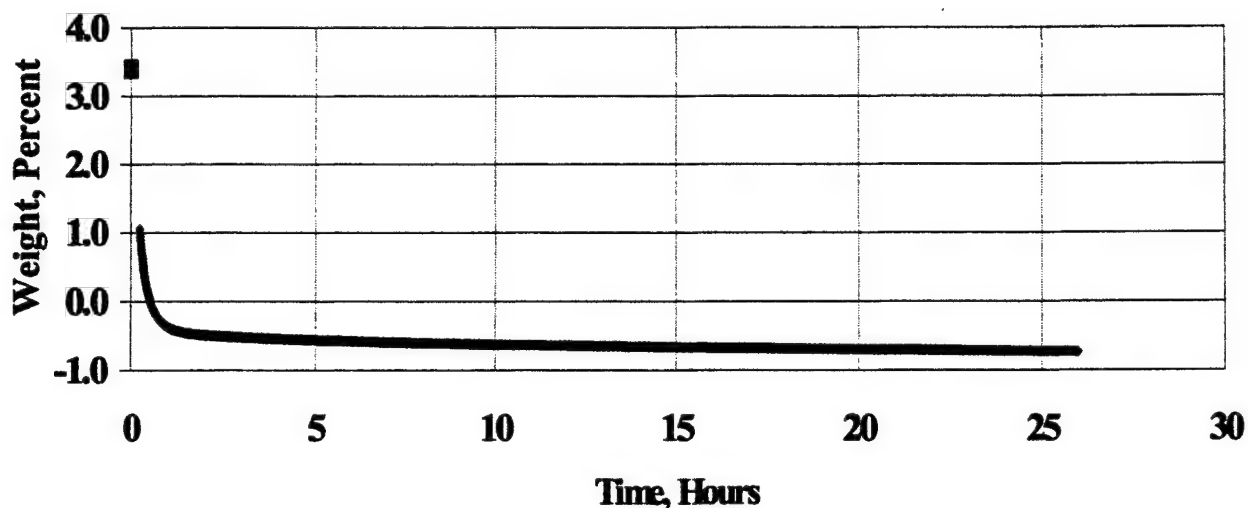


Figure 2. Desorption Diffusion (30 °C) of Supercritical Carbon Dioxide from Polymeric Materials: PIP (0131d)

Replicate specimens of PC, PVC, and PPO had reproducible 'Extractables' and 'Corrected Sorption Values' (columns 5 and 3 respectively, Table 11). The PMMA Extractable values were dissimilar, but small relative to the sorption, therefore, the rankings were identical. Note that the reproducibility and accuracy of the extractable determination is dependent on the attainment of a plateau in the continuous microbalance desorption process. Alternatively, the specimen mass could be determined after a longer period by removal from the continuous microbalance monitoring instrument and weighing on an independent macrobalance. This would also reduce the specimen residence time in the microbalance and increase specimen throughput.

About half of the materials had significant extractables under the processing conditions. Therefore, the migration of extractables cannot be ignored in the evaluation of material compatibility. The extractable adjustment is a systematic error that underestimates the true SCCO₂ sorption value. Furthermore, this error is not a constant offset for all materials and is shown here to vary considerably with polymer structure and formulation.

3.3 Comparison of Sorption Values with Correction to Zero-time Mass Based on High Concentration Desorption Extrapolations.

Most of the sorption values reported in the literature are based on an initial measurement that is often performed after considerable desorption has occurred. This desorption occurs between the time the specimen is removed from the liquid and the initial weighing; the more volatile the liquid the higher the systematic error. Supercritical carbon dioxide is an even greater experimental challenge because the true equilibrium sorption value exists at elevated temperature and pressure. The decompression period adds further uncertainty regarding the zero-time value in desorption kinetics. The end of the decompression period was arbitrarily

defined as the zero-time because we were able to hold the time-to-decompress from high to ambient pressure to a fixed 1-min interval. If the decompression period was variable, the start of the decompression process would be a better kinetic zero-time.

Figure 3 provides a Fick's Law plot of time^(1/2) versus reduced mass showing the extrapolation back to an adjusted zero-time sorption value for poly(isobutylene) (PIB). The back extrapolation for this elastomer is characteristically long, however, rapidly sorbing and desorbing polymers such as PDMS are even more extreme.

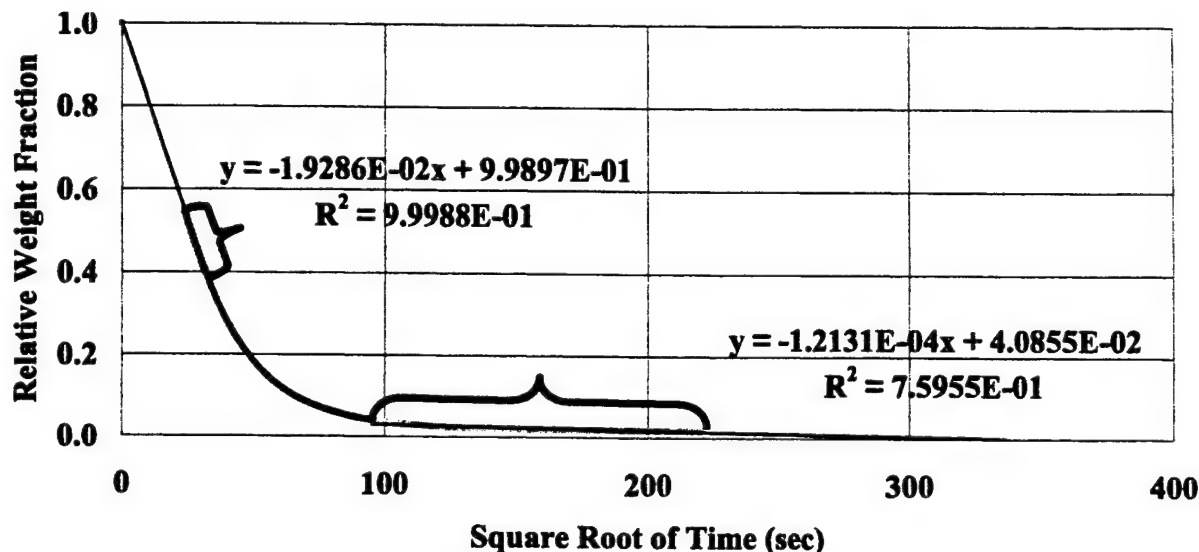


Figure 3. Fick's Law Plot of Desorption Diffusion (30 °C) of Supercritical Carbon Dioxide from Polymeric Materials: PIB (0137d)

Due to this lag before the initial sorption measurement, the traditional reported measurements give systematically low sorption values that underestimate the actual degree of interaction and solubility of fluids such as supercritical carbon dioxide in materials. In Table 12, the 'zero-time corrected sorption' values are calculated, followed by the error in ignoring the desorption during the 7 to 12-min TGA experiment and the 20-min measurement delay.⁶⁻⁸ Large systematic relative errors of -15 to -86% were suffered by ignoring the extrapolation to zero-time. The methodology was capable of correcting for this measurement time lag after decompression and improving the ranking the materials. One can observe from the last two columns that there would be large ranking errors and polymer-fluid interaction errors from not employing the methodology for extrapolating to the end-of-decompression. The replicates of PVC, PC, and PMMA showed good sorption reproducibility, whereas PPO replicates had a larger difference of 3.75 versus 4.3% or standard deviation of 6.7% relative.

Table 12. Comparison of Sorption (%) Corrected for Extrapolation to Zero-time at the end of the Decompression Period Versus Uncorrected Sorption after 7-12 min and 20 min (6-8)

No.	Polymer Codes	Sorption, Zero-time Corrected	Sorption at 7-12 min, % (Relative Error, %)	Sorption at 20 min, % (Relative Error, %)
1.	PDMS, 139d	0.44	0.13 (-70.3)	0.06 (-86.8)
2.	PIF, 0151z	1.09	0.16 (-22.5)	0.04 (-80.0)
3.	PVC, 0089d	1.47	1.16 (-21.3)	1.05 (-28.8)
4.	PEEK, 154z	1.49	0.78 (-34.7)	0.60 (-50.3)
5.	PVC, 0110z	1.65	1.37 (-17.2)	1.20 (-27.2)
6.	PTFEP, 153z	2.39	1.68 (-24.7)	1.31 (-41.3)
7.	PC, 0082d	2.46	1.85 (-21.5)	1.48 (-37.1)
8.	PC, 0117D	2.62	1.85 (-25.8)	1.48 (-40.5)
9.	PBB, 0138d	3.12	1.41 (-52.8)	0.90 (-70.0)
10.	PEP, 0130d	3.22	1.53 (-50.7)	0.93 (-70.0)
11.	PPO, 0091d	3.64	2.57 (-29.5)	1.97 (-45.7)
12.	ABS, 0115d	3.75	2.86 (-23.2)	2.37 (-36.3)
13.	PIP, 0131d	4.12	1.08 (-68.2)	0.60 (-82.4)
14.	PPO, 0096d	4.29	2.74 (-36.1)	2.05 (-52.2)
15.	PSB, 0140d	4.72	3.32 (-29.3)	2.76 (-41.4)
16.	SMO, 0129d	4.94	3.92 (-20.8)	3.50 (-29.2)
17.	PMMA, 075z	5.83	4.82 (-17.3)	4.30 (-26.2)
18.	PMMA, 105z	6.24	5.26 (-15.7)	4.67 (-25.2)
19.	PU, 0124d	7.08	5.07 (-25.5)	4.19 (-38.4)
20.	PSBR, 143z	7.32	3.67 (-44.3)	1.87 (-71.6)
21.	PIB, 0137d	7.88	4.36 (-44.7)	2.72 (-65.5)

3.4 Time for Complete Desorption and Reuse of Sensitive Equipment after Exposure Employing Fick's Law Low Concentration Diffusion Equations.

It is important to establish the time required for complete desorption of all carbon dioxide from the material before equipment can be reused after decontamination. Residual decontaminant such as carbon dioxide or fluorocarbon cleaning fluids can plasticize the polymer and decrease certain properties that might cause failure under use conditions. The ability of the measurement and data reduction process to provide this type of "time for complete desorption" values is demonstrated in Table 13. The continuous measurement of desorption allowed the best possible estimate of the time to complete desorption because the high data densities provided robust extrapolations to the time required for the material specimen to regain its original weight. The approach to this final equilibrium can be extremely slow, however, and the continuous, high data densities combined with a Fick's Law diffusion coefficient allowed extrapolation to the time axis zero-mass values.

An example of a Fick's Law plot for Silicone Modified Organic (SMO) polymer is shown in the Figure 4. The mass has been normalized from 0 to 1 on the y-axis and the Fickian time^(1/2) is employed on the x-axis. The Fick's Law equations for the linear portion of

the initial and final desorption are shown adjacent to their respective section of the plot. The thinner line denotes the extrapolated section of the curve at both extremes of the plotted data. One can see the extrapolation to zero-time on the x-axis that defines the time-to-complete-desorption; this value can be used to specify the time-to-reuse for decontaminated items.

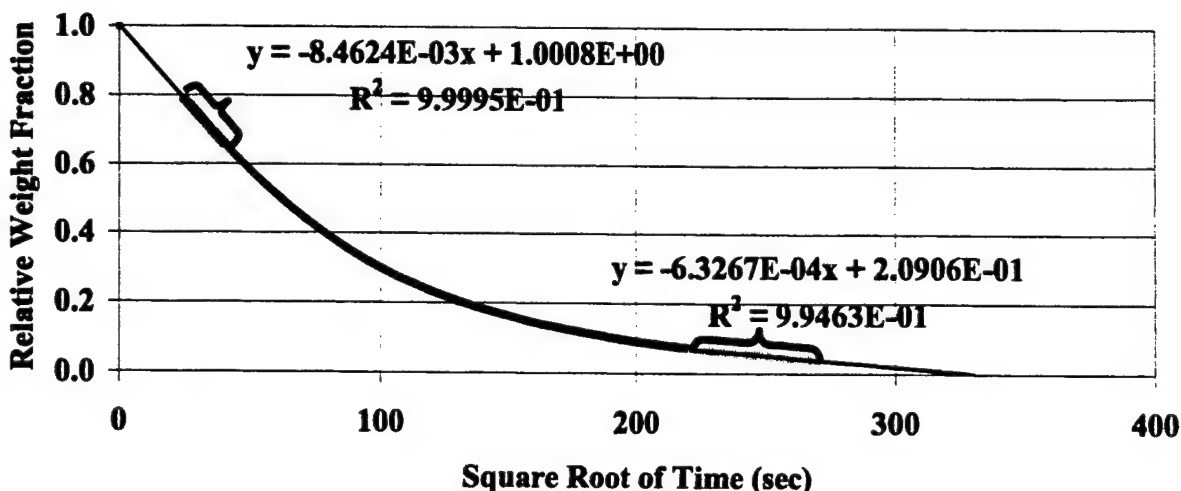


Figure 4. Fick's Law Plot of Desorption Diffusion (30 °C) of Supercritical Carbon Dioxide from Polymeric Materials: SMO (0129d)

The time for complete desorption is reported, followed by the Fickian diffusion equation and diffusion coefficient in the last two columns of Table 13. One can see that the methodology is capable of ranking the materials based on the time required to return to the unplasticized condition after super critical carbon dioxide exposure. For the materials studied, this period ranged from about 1 to 5 days.

The calculation of an extrapolated time to complete desorption can be sensitive to several processes influencing the data near the initial baseline, which are the presence of mobile extractables in the materials and the length of the experiment and degree to which the decontaminant has approached a plateau. Desorbing polymers with shorter experiment times that are not close to the baseline require longer extrapolation periods, increasing the potential error. The permutations of categories of data sets have been organized according to the following two processes:

- the low concentration desorption can be at a zero plateau or continuing to decrease toward a desorption mass change plateau
- the final mass relative to the baseline can be near zero, below zero (indicating extraction has occurred), or above zero (indicating the desorption was so slow the experiment had to be terminated before nearing complete desorption). The number of polymers in the various combinations of these two conditions have been tabulated and reported in Table 14.

Table 13. Time for the Complete Desorption of all Carbon Dioxide from Polymeric Materials Based on a Fick's Law Extrapolation of Low Concentration Desorption Diffusion

No.	Polymer Codes	Time for Complete Desorption hrs (days)	Fickian Diffusion Equation: Relative Mass Fraction =	Diffusion Coefficient, cm ² /sec
1.	PEP, 0130d	20.6 (0.9)	0.038 – 1.38E-4 time ^(1/2)	5.7250E-11
2.	PU, 0124d	20.7 (0.9)	0.050 – 1.83E-4 time ^(1/2)	7.5549E-11
3.	PTFEP, 153z	22.4 (0.9)	0.083 – 2.92E-4 time ^(1/2)	1.5448E-10
4.	PBB, 0138d	23.5 (1.0)	0.056 – 1.91E-4 time ^(1/2)	7.9684E-11
5.	PSB, 0140d	24.2 (1.0)	0.042 – 1.44E-4 time ^(1/2)	1.4751E-10
6.	PIP, 0131d	24.4 (1.0)	0.070 – 2.38E-4 time ^(1/2)	1.2030E-10
7.	PVC, 0089d	29.1 (1.2)	0.288 – 8.90E-4 time ^(1/2)	1.5727E-09
8.	SMO, 0129d	30.3 (1.3)	0.209 – 6.33E-4 time ^(1/2)	2.8522E-09
9.	PIB, 0137d	31.5 (1.3)	0.041 – 1.21E-4 time ^(1/2)	3.0844E-11
10.	PEEK, 154z	38.7 (1.6)	0.163 – 4.38E-4 time ^(1/2)	9.4139E-11
11.	PSBR, 143z	40.5 (1.7)	0.081 – 2.11E-4 time ^(1/2)	9.3694E-11
12.	ABS, 0115d	42.8 (1.8)	0.124 – 3.15E-4 time ^(1/2)	4.8703E-10
13.	PI, 0151z	46.4 (1.9)	0.363 – 8.88E-4 time ^(1/2)	1.1647E-10
14.	PMMA, 075z	53.8 (2.2)	0.433 – 9.84E-4 time ^(1/2)	1.8087E-09
15.	PC, 0117d	57.9 (2.4)	0.119 – 2.60E-4 time ^(1/2)	1.1518E-10
16.	PVC, 0110z	60.0 (2.5)	0.175 – 3.77E-4 time ^(1/2)	3.2042E-10
17.	PPO, 0091d	61.2 (2.5)	0.151 – 3.22E-4 time ^(1/2)	1.6204E-10
18.	PPO, 0096d	66.8 (2.8)	0.092 – 1.88E-4 time ^(1/2)	5.0719E-11
19.	PC, 0082d	72.2 (3.0)	0.099 – 1.94E-4 time ^(1/2)	5.7604E-11
20.	PDMS, 139d	83.0 (3.5)	0.110 – 2.02E-4 time ^(1/2)	1.1404E-10
21.	PMMA, 105z	130.1 (5.4)	0.199 – 2.90E-4 time ^(1/2)	1.6240E-10

Table 14. Number of Polymeric Materials in Various Cases Based on Desorption Relative to the Baseline and a Decrease or Plateau Approaching the Baseline

Case Code	Low Concentration Desorption Relative To Zero Baseline	Plateau or Decreasing Desorption Approaching the Baseline	Number of Polymeric Materials in Case, (% of Total)
NZP	<u>N</u> ear <u>Z</u> ero	Plateau	2 (9.5%)
NZD	<u>N</u> ear <u>Z</u> ero	Decreasing	1 (5%)
BZP	<u>B</u> elow <u>Z</u> ero	Plateau	3 (14%)
BZD	<u>B</u> elow <u>Z</u> ero	Decreasing	7 (33%)
AZP	<u>A</u> bove <u>Z</u> ero	Plateau	2 (9.5%)
AZD	<u>A</u> bove <u>Z</u> ero	Decreasing	6 (29%)

Most of the data reduction challenges from the diverse types of desorption plots were handled by the calculation procedures outlined in Table 9, with respect to assigning Case 1, 2, or 3 to the procedures. The NZP case in Table 14 is the simplest to analyze because the extrapolated time to complete desorption almost lies on the reduced mass plot. Likewise, the NZD case only requires a short extrapolation. Together, these only account for about 15% of the materials. About 47 % of the materials desorbed to below the zero mass baseline, indicate some extractables were present. These cases present a problem in defining the last mass data point for the reduced mass calculation. The BZP data sets can be handled by regressing that portion of the data set parallel to the baseline to define the onset of deviation from this plateau. This mass-time point would then be defined as the end of the desorption process. The low concentration diffusion would then be based on the Fickian regression of the last 3-10% of the data set above this reduced mass. The AZP cases are estimated to be caused by a shift in the specimen position and baseline. Again, this data case was handled by regressing that portion of the data set parallel to the baseline to define the onset of deviation from this plateau. The AZD case consists of materials with slow desorption for which the experiment was terminated early to increase the productivity of the instrument. If the data set did not extend to about 5% reduced mass remaining, the decontaminant-material might not have been in the low concentration Fickian region, and the extrapolation would lead to systematically low time-to-complete desorption. This case is best handled by repeating the experiment and establishing a criterion for terminating all experiments at less than about 5% mass remaining.

- Replicates. Measurement replicates and an analysis of reproducibility were not planned for this initial stage of the investigations; however, several paired specimens were evaluated to obtain some preliminary indications on trends or difficulties in data analysis. Four specimen pairs were evaluated: PVC, PMMA, PPO, and PC, and each is discussed below.

- PVC. The desorption time difference between the PVC repetitions is relatively high. Inspection of the Fick's Law and reduced mass versus time plots show a smooth, well-behaved approach to zero mass for both specimens. The PVC specimen with the longer desorption time had the higher initial carbon dioxide sorption ($1.65 > 1.47\%$), and some part of the longer time might be attributed to this higher carbon dioxide content. The preferred PVC desorption time is the mean of 1.85 days.

- PMMA. A parallel comparison of the PMMA replicates yields a relatively high desorption time difference. Inspection of the low concentration Fick's Law diffusion extrapolation shows the lower desorption was produced by an extrapolation from about 20% from the baseline, whereas the longer complete desorption time extrapolation was from about 5%. Therefore, the 5.4 day "Time to Complete Desorption" is the preferred value (PMMA 105z). The longer desorption time was also from the specimen with the higher initial sorption value ($6.4 > 5.8\%$).

- PC. The PC comparison of replicates shows a relatively small difference in initial sorption and desorption time. The Fick's Law plots overlay closely, even though there was balance instability at several time intervals (in PC 0082d). Because both replicates qualify as a statistical sample, the mean time of 2.7 days is the preferred value.

- **PPO.** The PPO replicates belong to the AZP case; the curves came to a plateau slightly above the zero-mass baseline. The low concentration diffusion coefficient regression and extrapolation was heavily weighted by a large fraction of the data set with a significant, nominal positive mass. The "time to complete desorption" was, therefore, erroneously extended to longer time values. This case was handled by regressing the plateau portion of the data set parallel to the baseline to define the onset of deviation from this plateau. The onset of deviation was defined as the end of the desorption data set, and the low concentration regression was calculated from onset to 3-10% higher residual mass values. The revised extrapolations are reported in Table 14. This data reduction procedure resulted in much closer agreement between replicates (2.5 versus 2.8 days). These data analysis procedures are being formalized for future studies but have not been auto-programmed into the data reduction software since some degree of judgment is still required.

3.5 Indentation Hardness.

Chemical exposure often influences the surface properties of materials that are critical to their performance. Indentation hardness is one of the most important of these surface properties. The values of the unexposed baseline measurements were compared with values after exposure and are documented in Table 15. About a third of the materials exposed to supercritical carbon dioxide showed surface hardening of about 1 to 3%. Another one-third experienced surface softening of over ca 1%. Note that the measurement shows the relatively low level of surface change after the plasticizing supercritical fluid had completely desorbed; measurements performed while a significant fraction of the decontaminant was still present resulted in larger changes. The methodology was capable of ranking the materials based on these longer-term indentation effects.

4. DISCUSSION

Sorption and desorption diffusion coefficient measurements by TGA were useful in characterizing the plasticization of polymeric materials by supercritical carbon dioxide.⁹ The sorption value measured includes solubility and void pressurization. The diffusion coefficient equations allowed a calculated estimate of the time required to return to the unplasticized state. The time determined to return to the initial unplasticized weight does not include the potential effects of residual trace carbon dioxide on glass transition temperature and crystallinity. Dynamic Mechanical Thermal Analysis (DMTA) studies of these effects as a function of desorption time are in progress. Indentation measurements showed slight changes after complete desorption. The continuous desorption curve measurement allowed adjustment and correction for extractables and the zero-time sorption measurement-lag after decompression; these corrections eliminated very high relative errors for many polymers.

The low concentration diffusion coefficient is sensitive to the interpretation of the plateau value near the zero baseline. The slope and diffusion coefficients have very low values of 10^{-9} to 10^{-10} cm²/sec for carbon dioxide. Therefore, the offset from the zero baseline due to extractables or slow equilibration will influence the extrapolations to a time-axis intercept. The goal is a set of data reduction procedures independent of operator interpretation. This process has been initiated by formulating several data analysis cases and rules, provided in Table 9 and 14.

Table 15. Indentation Hardness Changes to Polymeric Materials after Exposure to Supercritical Carbon Dioxide, Followed by Complete Desorption: Exposed to 1400 psig at 50 °C for 15 min

No.	Polymer Codes	Scale	Baseline	Final	Change, %
1.	PVC, 0110z	Shore D	ND	ND	ND
2.	PSB, 0140d	Shore D	63.6	45.8	-28.0
3.	PVC, 0089d	Shore D	73.4	71.5	-2.6
4.	PC, 0082d	Shore D	76.5	75.1	-1.8
5.	PMMA, 105z	Shore D	82.0	81.0	-1.2
6.	PC, 0117d	Shore D	76.9	76.1	-1.0
7.	PMMA, 075z	Shore D	80.2	79.5	-0.9
8.	PTFEP, 153z	Shore A	91.7	91.2	-0.5
9.	PIF, 0151z	Shore D	82.5	82.2	-0.4
10.	PU, 0124d	Shore A	96.9	97.0	0.1
11.	PEP, 0130d	Shore A	93.6	93.9	0.3
12.	PPO, 0096d	Shore D	75.6	75.8	0.3
13.	PPO, 0091d	Shore D	76.2	76.6	0.5
14.	SMO, 0129d	Shore A	58.6	58.9	0.5
15.	PEEK, 154z	Shore D	76.4	77.0	0.8
16.	ABS, 0115d	Shore D	72.6	73.4	1.1
17.	PSBR, 143z	Shore A	85.8	87.1	1.5
18.	PDMS, 139d	Shore A	63.9	64.9	1.6
19.	PIB, 0137d	Shore A	66.2	67.7	2.3
20.	PIP, 0131d	Shore A	66.9	68.7	2.7
21.	PBB, 0138d	Shore A	65.9	67.8	2.9

The sorption measurement desired is the value under supercritical conditions, however, the ability to measure values under these pressure and temperature conditions is currently limited. The relatively rapid 1-min decompression time maximizes our ability to measure the sorption as quickly as feasible. The ability to analyze polymer trends was confounded by attempting to use the sorption values without the corrections determined here. With these adjusted values, sorption trends can be correlated with structure, polymer solubility phase diagrams, or solvent-solute parameters. These correlations will assist in the selection of the optimal solvent class (supercritical or fluorocarbon) or temperature and pressure conditions. Classes or categories of materials that can or cannot withstand the cleaning process can also be identified. The further evaluation of the results can be provided in future publications.

There is an overall need for a measure of the desorption time required to deplasticize a material from sorbed decontaminant chemicals and return the material to its initial glass transition temperature and material properties that are dependent on plasticization and glass transition temperature. The diffusion measurements reported herein might be further exploited to provide a generalized limiting measure of the most rapid desorption feasible for any future decontaminant, because carbon dioxide is a favorable molecular prototype in terms of low

molecular cross-section. Therefore, most liquids such as fluorochemicals and solvent-based decontaminants (Decon Green) should have higher molecular cross-sections and slower returns to the initial glass transition temperature.

5. CONCLUSIONS

A methodology was developed and applied for evaluation of desorption diffusion of decontamination extractants such as supercritical fluids and fluorocarbons. The instrumentation and methods were capable of ranking polymeric materials based on interaction with supercritical carbon dioxide for several types of measurements. These measurements included: sorption, corrected for fraction of polymer additives extracted; sorption, corrected for extrapolation to the end of decompression; time for complete desorption to the initial weight; low-concentration diffusion coefficient; and change in surface indentation hardness.

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APPENDIX A

COMPUTERIZED PROCEDURES

Table Desorption Experiment Procedures for Thermogravimetric Instrumentation

Purpose	Steps
Initiate TA2100 Data acquisition	Reboot PC: Ctrl-Alt-Del Key F1 to select TGA mode Key F5 to Reconfigure, if needed ESC to enter Main Menu
Zero the empty specimen holder	Select F6: Signal Control Select: F1 Autozero
Weigh the specimen before chemical exposure	Open Furnace, insert specimen, close furnace Record weight on spreadsheet Remove specimen and submit to chemical exposure
Display and edit experimental parameters	Select F12 Instrument Control Select F4 Experimental Parameters Select Sample Info Select F1 Edit sample experimental parameters Scroll through and key in values Select F8 Accept Form ESC to Main Menu
Display and edit Method parameters	Select F2 Method Scroll to select Method ESC to finalize selection and return to Menu
Pre-equilibrate oven to desorption temperature	Select F1 Start
Pre-desorption experimental preparation	Key F12 Instrument Control Key Signal Control Key F1 Autozero Key F12 Instrument Control Key F3 Reject and Yes to end equilibration
Load chemically exposed specimen for desorption	Weigh specimen on Macrobalance Open furnace, load specimen, close furnace F4 to enter Elapsed time, Initial weights F1 Esc to Main Menu F1 Start
Display plot of data	Select F8 Utilities Select F1 Directory Select F3 Esc
Update Data plot	F7 New Data Limit F1No Limit

Table Data Analysis File Transfer Procedures

Purpose	Steps
File transfer from TA2100 to DOS on same PC	<ul style="list-style-type: none"> • Reboot PC to exit TA2100: Alt-Ctrl-Del • Insert diskette for data file • F2 key to select DOS
Copy binary file from TA2100 directory to DOS directory	<ul style="list-style-type: none"> • Key "tadir data" DOS command to list TGA data files • Note filename for transfer • Key "taget filename" >"1 File copied"
Convert DOS binary to ASCII format	<ul style="list-style-type: none"> • Key "taconvrt", Enter; key in at prompt: "Name of binary TA data file:" • Key "filename.0#)" (pmma0123d.01) • ASCII: filename.01a (pmma0123d.01a) • Parameter Block: Key Yes
Filter data set by selecting the range and averaging set	<ul style="list-style-type: none"> • Data size: 1 (=All data) • Data points: 3 (Least Square Average groups of N points) • Key point number (e.g. 50 for a plot, 3-9 for calculations) • Wait for prompt > • Control-C to return to DOS Prompt
Transfer file to diskette	<ul style="list-style-type: none"> • Key "copy filename.01a a:"
Transfer file from diskette to PC with the Diffusion Coefficient Data Analysis Program	<ul style="list-style-type: none"> • Highlight and Drag filename from a: diskette to DATA and ANALYSIS Folders
Convert data filename to code recognized by ANALIZ diffusion coefficient calculations	<ul style="list-style-type: none"> • Open Analysis Folder, then open <i>polymer.ini</i> • Create a New line at the end of the file, but before the end-of-file control character. • Key in next Material Code by incrementing the current Code number • Document the Material nomenclature employing conventions and delimiters • Click File, Save
Rename the TGA data file to the coded ANALIZ filename	<ul style="list-style-type: none"> • Open Analysis Folder • Highlight TGA filename, • Key in coded name
Convert TGA file to Coded ANALIZ file structure	<ul style="list-style-type: none"> • Highlight Coded filename, • Select Open in Word for large files • Delete first 20 lines of header parameters, • Delete any blank lines at top of data file, Delete any non-data lines at end of data file, • File>Save, • Select "Text document" (ASCII without control characters) • Close

Table Data Analysis File Transfer Procedures (Continued)

Purpose	Steps
Input specimen data for diffusion calculations	<ul style="list-style-type: none"> • Open INPUT database form; • Key in coded filename, • Check that the correct polymer nomenclature is displayed. • Key in specimen parameters as prompted,
Set temporary value for initial weight at desorption zero-time	<ul style="list-style-type: none"> • Key in the highest weight value from TGA plot or TGA data file
Complete the input portion of the database form	<ul style="list-style-type: none"> • Last input: "Time lapsed between sample blotting and loading" Or "Initial Durameter Hardness" when available; • File>Save>Close
Check for the creation of the correct file.dta filename in Analysis Folder	<ul style="list-style-type: none"> • Open Analysis Folder or use Explorer>Find

Table Procedure for Calculation of Diffusion Coefficients

Purpose	Steps
Calculate the extrapolated weight at zero-time for desorption: Sample weight when removed from exposure fluid	<ul style="list-style-type: none"> • Run ANALIZ • Key in filename (##-##-#) • Examine 2 plots displayed • Examine the data near the early data points for a linear region to use for the extrapolation • Examine the lower plot of the entire data set for anomalies • Key Enter/Any
Define data range used for extrapolation	<ul style="list-style-type: none"> • Examine the Weight versus Square Root of Time plot • Click on 2 points in the early desorption data; range lines appear after the second click • Key Enter
Select the Extrapolated Weight at zero-time	<ul style="list-style-type: none"> • Observe the display of regression parameters • Determine if the y-intercept value is reasonable • Key in a weight at zero-time at the prompt • Key Enter, Control-C to exit
Input the Extrapolated weight at zero-time into INPUT database	<ul style="list-style-type: none"> • Open INPUT • Open filename ##-##-# • Scroll to "Initial Weight of Specimen" • Key in weight from y-intercept extrapolation • File>Save
Set up calculation of diffusion coefficients using extrapolated weight at zero-time	<ul style="list-style-type: none"> • Open ANALIZ • Open filename • Key in Extrapolated weight again

Table Procedure for Calculation of Diffusion Coefficients (Continued)

Purpose	Steps
Select the range of desorption data for calculation of the diffusion coefficient by Method 1	<ul style="list-style-type: none"> • Examine plot for linear Fickian region • Key in "Yes" if there is a linear region for the calculation of a diffusion coefficient; for the Question Prompt: Is the plot Fickian? • Key in values to define the calculation range in terms of fractional weight remaining • Click on a high and low coordinates to define the range; repeating or altering the Keyed-in ranges • Key in Enter
Select ranges for Method 2, Low Concentration diffusion coefficient	<ul style="list-style-type: none"> • Examine the plot of the last 20% of the weight loss recorded; note, the relative weight might not include the complete curve • Click on 2 coordinates on the plot to define the range
Select ranges for a Series Solution for the diffusion coefficient	<ul style="list-style-type: none"> • Examine the plot of the natural log relative weight versus time • Click on 2 points for calculation of an initial extrapolated weight • Examine the replotted data set for selection of a linear range • Click on 2 coordinates on the plot to select the range for the Series Solution calculation
Record calculated results from the display	<ul style="list-style-type: none"> • Document value: "Time at 99% desorption flux", since this value is not printed from INPUT database
Document diffusion coefficient calculations	<ul style="list-style-type: none"> • Open INPUT database • Select filename from File>Open • Print INPUT database form from File>Print • Exit

APPENDIX B

DESORPTION DIFFUSION COEFFICIENT DATA SETS AND COMPUTATIONS

FIGURE . CHEMICAL-MATERIAL INTERACTION DATA SET:
Supercritical Carbon Dioxide and Polycarbonate

PC

Sorption, Desorption Diffusion, and Indentation Data Sets

Material Data

Test Reference Number:	<u>04-1-1</u>	TGA Filename:	<u>pc0082d</u>
Property Test Specification:	ASTM D471/D543		
Material Name:	<u>Polycarbonate</u>	Material Code:	<u>PC</u>
Material Supplier:	<u>Harbor City Plastics</u>	Material Class:	<u>TP</u>
Monomer Source:	<u>General Electric</u>	Base Polymer (Lot. No.):	<u>(LBR567)</u>
Exposure Liquid:	<u>Supercritical Carbon Dioxide</u>	Replicate Number:	<u>1</u>

Pre-Exposure Data

Measured Diameter (mm):	<u>10.20</u>	<u>10.08</u>	<u>10.02</u>	<u>10.17</u>	
Mean Diameter:	<u>10.118</u>				
Measured Thickness (mils):	<u>34.60</u>	<u>35.20</u>	<u>34.80</u>	<u>34.80</u>	
Mean Thickness:	<u>34.850</u>				
Initial Sample Weight (mg):	<u>79.822</u>				
Initial Durometer Hardness:	<u>76.5</u>	Scale: SHORE	<u>D</u>		
				95% Confidence Level (CL):	<u>0.131</u>
				95% Confidence Level (CL):	<u>0.400</u>

Sample Exposure Data

Exposure Date:	<u>03/22/00</u>	Time:	<u>11:33:00</u>	
Removal Date:	<u>03/22/00</u>	Time:	<u>11:48:00</u>	
Total Exposure Time (h:m:s):	<u>00:15:00</u>	Weight of Sample After Exposure (mg):	<u>81.70</u>	
Weight Gain (mg):	<u>1.88</u>	Percent Weight Gain:	<u>2.36</u>	
Final Durometer Hardness After Desorption:	<u>75.1</u>	Percent Hardness Change:	<u>-1.8</u>	

Desorption Experiment

Mean Temperature of Desorption Experiment (setpoint = 30 deg C):	<u>30.000</u>	95% CL:	<u>0.0007</u>
Time Lapse Between Sample Exposure and Sample Desorption (sec):			<u>480</u>
Equilibrium Weight of Desorbed Sample at 30 deg C (mg):			<u>79.740</u>
Sample Extracted (mg):	<u>0.08</u>	Solubility Corrected for Extractables (mg):	<u>1.96</u>
Sample Extracted (%):	<u>0.10</u>	Solubility Corrected for Extractables (%):	<u>2.46</u>

Diffusion Coefficient Data: Fick's Law

High Concentration Diffusion Coefficient (cm ² /sec):	<u>1.6572E-07</u>
Range Including Intercept (0,1), Relative Weight Fraction:	<u>1.00 - 0.65</u>
Linear Range of Desorption, Relative Weight Fraction:	<u>0.78 - 0.65</u>
Slope:	<u>-1.0379E-02</u>
X-axis Intercept:	<u>9.6722E+01</u>
R Square:	<u>0.99504</u>
Y-axis Intercept:	<u>1.0038E+00</u>
Low Concentration Diffusion Coefficient (cm ² /sec):	<u>5.7604E-11</u>
Linear Range of Desorption, Relative Weight Fraction:	<u>0.05 - 0.00</u>
Slope:	<u>-1.9350E-04</u>
X-axis Intercept:	<u>5.0965E+02</u>
R Square:	<u>0.85851</u>
Y-axis Intercept:	<u>9.8616E-02</u>

Wt. @ Zero Time, mg K 81.70	Wt. @ Zero Time, % L 2.353	Adjustment to TGA Time, sec M 480	Hardness Shore Scale N D
TGA Dry Wt., mg 79.822	Equil. Wt. Of Desorb. Sample 79.74	Min. Wt. Used For FDC, mg. 79.74	Pre Exposure Hardness 76.5
High Conc. DC, cm2/sec 1.6572E-07	Low Conc. DC, cm2/sec 5.7604E-11	Total Liquid Sorbed, mg. 1.878	Post Desorption Hardness 75.1
R Square 0.99504	R Square 0.85851		Change in Hardness, % -1.8
X Intercept 96.72	X Intercept 509.6		Mean Thickness, cm. 0.0885
Y Intercept 1.00383	Y Intercept 0.09862		
Y Intercept as Wt., mg. 82.013	X Intercept as Time, hrs. 72.2	X Intercept as Time, min. 432.9	pc0082d X Intercept as Time, days 3.0

TEMPERATURE STATISTICS

<i>Column1</i>		Max. TGA Wt., (orig data file) 81.296	TGA Wt. At 20 min. Adjustment 81.004
Mean	29.9997751	Sorption @ 7-12 min., mg	Sorption @ 20 min., mg
Standard Error	0.000349877	1.47	1.18
Median	30		
Mode	30.001	Sorption @ 7-12 min., %	Sorption @ 20 min., %
Standard Deviation	0.022304498	1.85	1.48
Sample Variance	0.000497491		
Kurtosis	1237.843422	Rel. Error (%) of 7-12 min. Sorp.	Rel. Error (%) of 20 min. Sorp
Skewness	-29.75049737	-21.5	-37.1
Range	1.222		
Minimum	28.983		
Maximum	30.205		
Sum	121919.086		
Count	4064		
Confidence Level(95.0%)	0.000685951		

HIGH CONCENTRATION DIFFUSION COEFFICIENT

pc0082d

SUMMARY OUTPUT

<i>Regression Statistics</i>	
Multiple R	0.997515832
R Square	0.995037835
Adjusted R Square	0.994822089
Standard Error	0.005089135
Observations	25

ANOVA

	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	1	0.119449449	0.119449449	4612.07371	5.21878E-28
Residual	23	0.000595684	2.58993E-05		
Total	24	0.120045133			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>
Intercept	1.00383392	0.004326717	232.0082228	2.935E-40	0.994883437	1.012784404
X Variable 1	-0.010378585	0.000152823	-67.91225005	5.2188E-28	-0.010694724	-0.010062446

LOW CONCENTRATION DIFFUSION COEFFICIENT

SUMMARY OUTPUT

<i>Regression Statistics</i>	
Multiple R	0.92655813
R Square	0.858509968
Adjusted R Square	0.858383975
Standard Error	0.005271814
Observations	1125

ANOVA

	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	1	0.18937359	0.18937359	6813.95486	0
Residual	1123	0.031210442	2.7792E-05		
Total	1124	0.220584032			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>
Intercept	0.098615531	0.001046021	94.27682236	0	0.096563154	0.100667908
X Variable 1	-0.000193497	2.34409E-06	-82.54668293	0	-0.000198096	-0.000188898

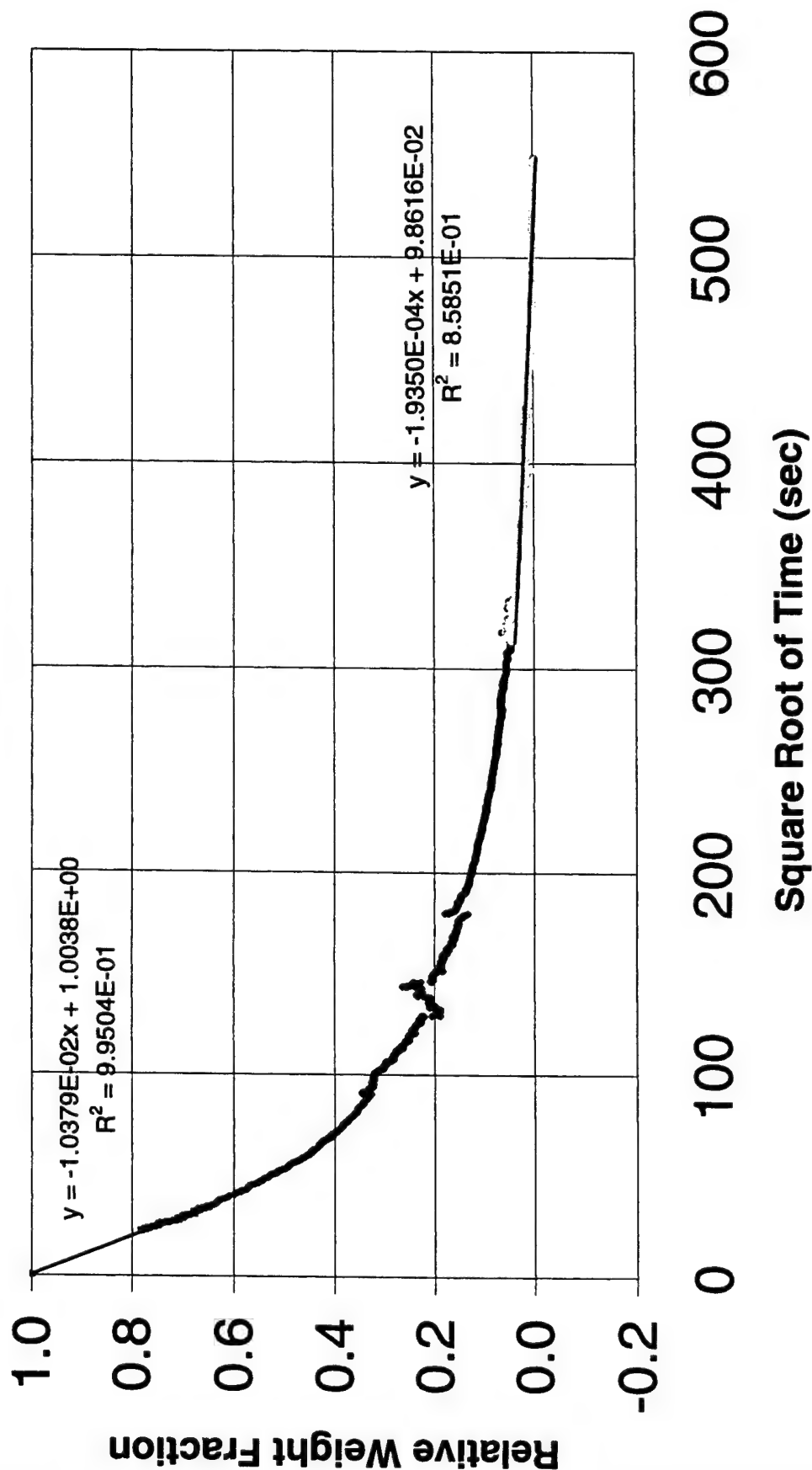
DIAMETER STATISTICS

<i>Column1</i>	
Mean	10.1175
Standard Error	0.04130678
Median	10.125
Mode	#N/A
Standard Deviation	0.08261356
Sample Variance	0.006825
Kurtosis	-3.032967
Skewness	-0.3232314
Range	0.18
Minimum	10.02
Maximum	10.2
Sum	40.47
Count	4
Confidence Level(95.0%)	0.13145673

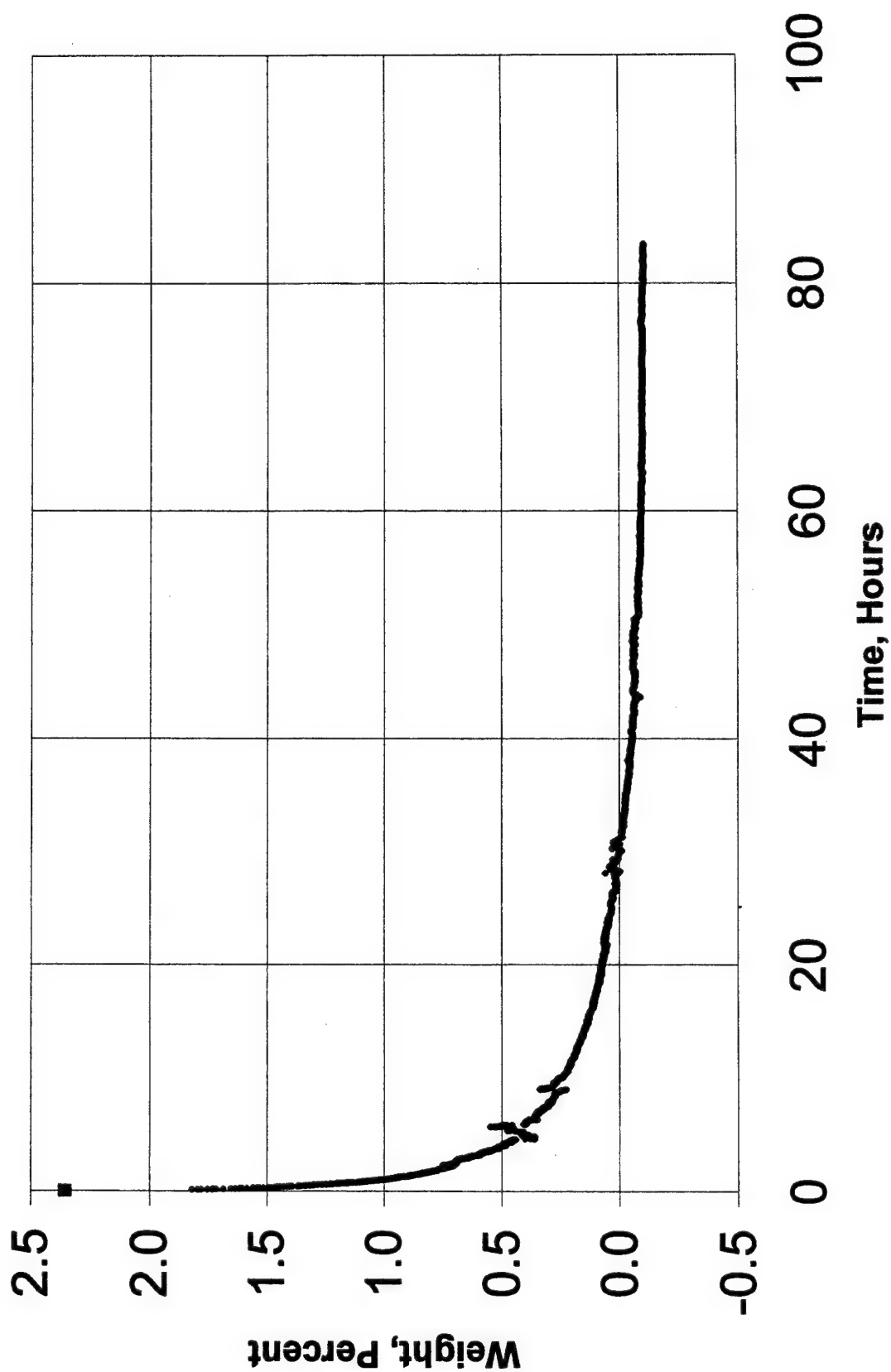
THICKNESS STATISTICS

<i>Column1</i>	
Mean	34.85
Standard Error	0.12583057
Median	34.8
Mode	34.8
Standard Deviation	0.25166115
Sample Variance	0.06333333
Kurtosis	2.22714681
Skewness	1.12933811
Range	0.6
Minimum	34.6
Maximum	35.2
Sum	139.4
Count	4
Confidence Level(95.0%)	0.40044942

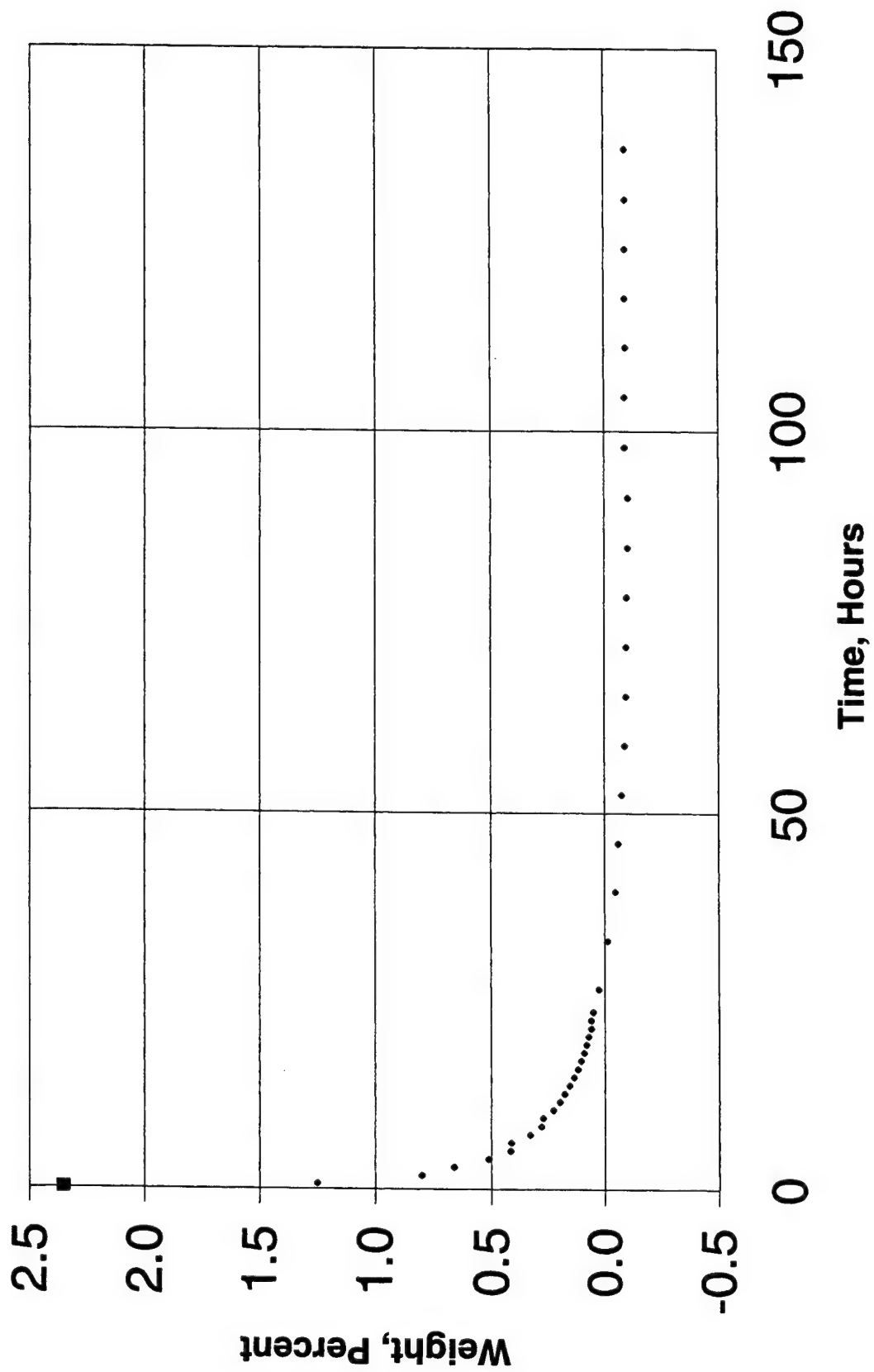
**Figure . Fick's Law Plot of Desorption Diffusion (30 degrees C)
of Supercritical Carbon Dioxide from Polymeric Materials:
PC (0082d)**



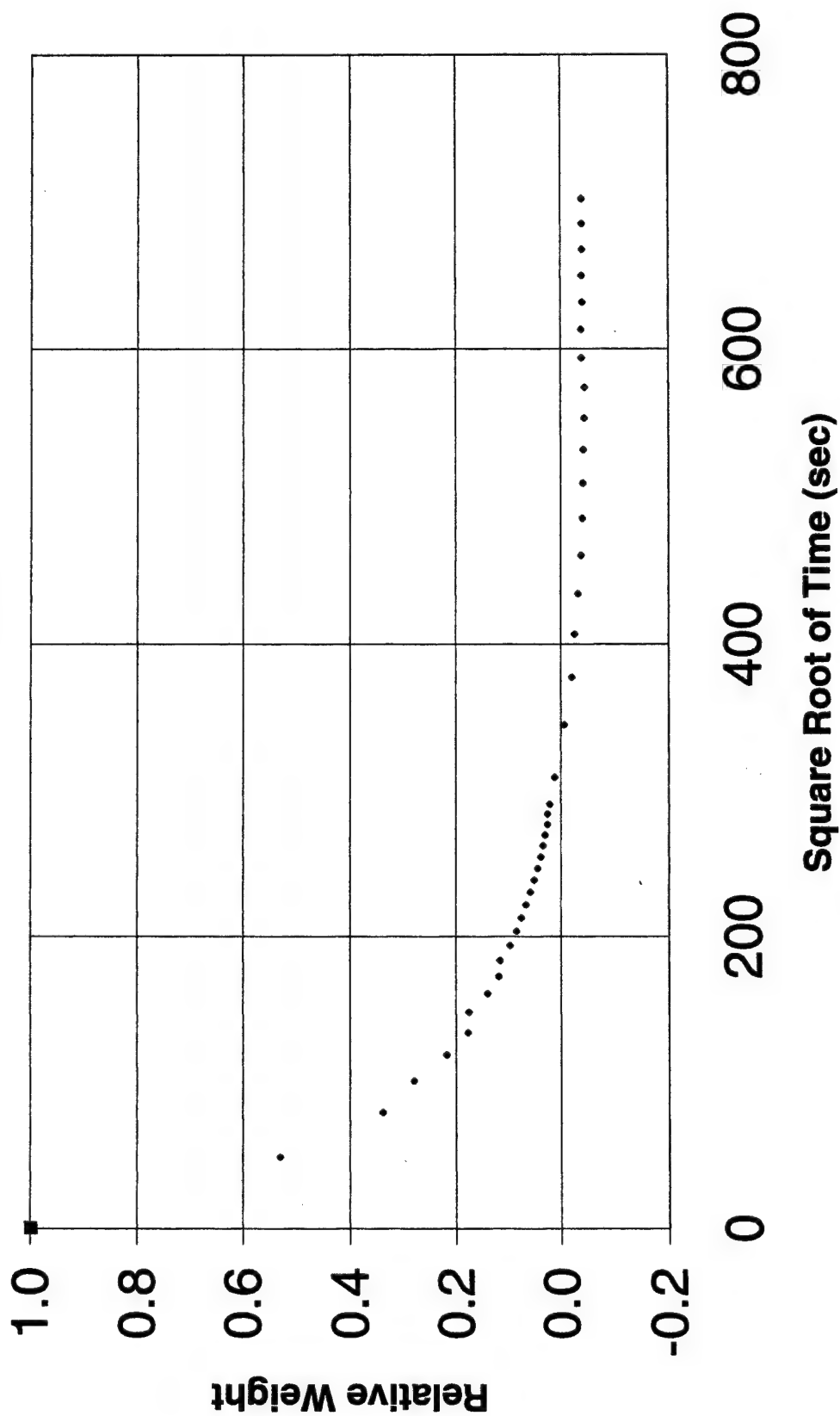
**Figure . Desorption Diffusion (30 degrees C) of Supercritical
Carbon Dioxide from Polymeric Materials: PC (0082d)**



**Figure . Desorption Diffusion (30 degrees C) of Supercritical
Carbon Dioxide from Polymeric Materials: PC (0082d)**



**Figure . Fick's Law Plot of Desorption Diffusion (30 degrees C) of
Supercritical Carbon Dioxide from Polymeric Materials:
PC (0082d)**



TGA Time, min	Temp., deg C	TGA Wt., mg	TGA Time, sec	Adjusted Time, sec	Adjusted Time, hr	Adjusted SORT Adj. Time, sec	Wt. Loss, %	Fractional Wt. Loss	Wt. @ Zero Time, mg	Wt. @ Zero Time, %	TGA Dry Wt., mg	Adjustment to TGA Time, sec	Hardness Scale
A	B	C	D	E	F	G	H	I	J	K	L	M	N
32.417	29.990	80.818	1945.020	2425.020	0.674	49.24	1.247	0.530	81.70	2.353	79.822	480	Shore D
97.464	30.000	80.458	5847.840	6327.840	1.758	79.55	0.797	0.339					
162.591	29.999	80.348	9755.460	10235.460	2.843	101.17	0.659	0.280					
227.651	30.000	80.231	13659.060	14139.060	3.928	118.91	0.512	0.218					
292.753	30.000	80.155	17565.180	18045.180	5.013	134.33	0.417	0.177					
357.780	30.000	80.152	21466.800	21946.800	6.096	148.14	0.413	0.176					
422.833	30.000	80.086	25369.980	25849.980	7.181	160.78	0.331	0.141					
487.904	30.000	80.046	29274.240	29754.240	8.265	172.49	0.281	0.119					
552.997	30.000	80.041	33179.820	33659.820	9.350	183.47	0.275	0.117					
618.075	30.000	80.005	37084.500	37564.500	10.435	193.82	0.229	0.097					
683.164	30.000	79.983	40989.840	41469.840	11.519	203.64	0.201	0.086					
748.254	30.000	79.965	44895.240	45375.240	12.604	213.01	0.179	0.078					
813.370	30.000	79.948	48802.200	49282.200	13.690	222.00	0.157	0.067					
878.426	30.000	79.932	52705.560	53185.560	14.774	230.62	0.138	0.059					
943.478	30.000	79.919	56608.680	57088.680	15.858	238.93	0.121	0.051					
1008.549	30.000	79.907	60512.940	60992.940	16.942	246.97	0.106	0.045					
1073.637	30.000	79.896	64418.220	64898.220	18.027	254.75	0.092	0.039					
1138.696	30.000	79.887	68321.760	68801.760	19.112	262.30	0.081	0.034					
1203.781	30.000	79.880	72226.860	72706.860	20.196	269.64	0.072	0.031					
1268.901	30.000	79.871	76134.080	76614.080	21.282	276.79	0.061	0.026					
1334.035	30.000	79.871	80042.100	80522.100	22.367	283.76	0.061	0.026					
1399.086	30.000	79.863	83945.160	84425.160	23.451	290.56	0.051	0.022					
1581.849	30.000	79.844	94910.940	95390.940	26.497	308.85	0.028	0.012					
1968.268	30.000	79.810	118095.960	118575.960	32.938	344.35	-0.015	-0.006					
2358.268	30.000	79.783	141496.080	141976.080	39.438	376.80	-0.049	-0.021					
2748.295	30.000	79.773	164897.700	165377.700	45.938	406.67	-0.061	-0.026					
3138.293	30.000	79.761	188297.580	188777.580	52.438	434.49	-0.077	-0.033					
3528.291	30.000	79.750	211697.460	212177.460	58.938	460.63	-0.091	-0.038					
3918.331	30.000	79.745	235099.860	235579.860	65.439	485.37	-0.096	-0.041					
4308.336	30.000	79.744	258500.160	258980.160	71.939	508.90	-0.098	-0.042					
4698.346	30.000	79.742	281900.760	282380.760	78.439	531.40	-0.100	-0.042					
5088.349	30.000	79.738	305300.940	305780.940	84.939	552.97	-0.105	-0.045					
5478.365	30.000	79.738	328701.900	329181.900	91.439	573.74	-0.106	-0.045					
5868.358	30.000	79.749	352101.480	352581.480	97.939	593.79	-0.092	-0.039					
6258.353	30.000	79.749	375501.180	375981.180	104.439	613.17	-0.092	-0.039					
6648.397	30.000	79.745	398903.820	399383.820	110.940	631.97	-0.096	-0.041					
7038.406	30.000	79.747	422304.360	422784.360	117.440	650.22	-0.094	-0.040					
7428.414	30.000	79.747	445704.840	446184.840	123.940	667.97	-0.094	-0.040					
7818.418	30.000	79.746	469105.080	469585.080	130.440	685.26	-0.095	-0.040					
8208.434	30.000	79.747	492506.040	492986.040	136.941	702.13	-0.094	-0.040					

Formulae Used for Analysis of Data
Uppercase letters refer to columns

Lowercase n refers to row, beginning with n=4

$Dn = (An * 60)$
 $En = (Dn + M4)$
 $Fn = (En / 3600)$
 $Gn = SQRT(En)$
 $Hn = ((Cn - L4) / L4) * 100$
 $In = ((Cn - L4) / (J4 - L4))$
 $K4 = (((J4 - L4) / L4) * 100)$
 $N16 = (((N12 - N8) / N8) * 100)$

Post Description
Hardness
75.1

Change in
Hardness, %
-1.83

Source binary TA data file : pc0082d.01

14 lines in the parameter block

3 channels of data

Run 22

Module TGA Aluminum Pans

Sample PC SCCO2 0082D

Size 81.296 mg

Method DESORPTION-Isothermal

Operator WJS

Comment Disk: 4x0.03 in. HP @ 1400x50 Dry Wt, TGA: 79.822 ET: 7:45

Nsig 3

Sig1 Time (min)

Sig2 Temperature (°C)

Sig3 Weight (mg)

Kcell 1.0000

Date 22-Mar-00

Time 11:56

FIGURE . CHEMICAL-MATERIAL INTERACTION DATA SET:
Supercritical Carbon Dioxide and Polycarbonate

PC

Sorption, Desorption Diffusion, and Indentation Data Sets

Material Data

Test Reference Number:	<u>04-1-2</u>	TGA Filename:	<u>pc0117d</u>
Property Test Specification:	ASTM D471/D543		
Material Name:	<u>Polycarbonate</u>	Material Code:	<u>PC</u>
Material Supplier:	<u>Harbor City Plastics</u>	Material Class:	<u>TP</u>
Monomer Source:	<u>General Electric</u>	Base Polymer (Lot. No.):	<u>(LBR567)</u>
Exposure Liquid:	<u>Supercritical Carbon Dioxide</u>	Replicate Number:	<u>2</u>

Pre-Exposure Data

Measured Diameter (mm):	<u>10.26</u>	<u>10.16</u>	<u>10.08</u>	<u>10.22</u>	
Mean Diameter:	<u>10.190</u>				95% Confidence Level (CL): <u>0.125</u>
Measured Thickness (mils):	<u>36.60</u>	<u>37.60</u>	<u>36.20</u>	<u>36.10</u>	
Mean Thickness:	<u>36.625</u>				95% Confidence Level (CL): <u>1.090</u>
Initial Sample Weight (mg):	<u>83.130</u>				
Initial Durometer Hardness:	<u>76.9</u>	Scale: SHORE	<u>D</u>		

Sample Exposure Data

Exposure Date:	<u>04/26/00</u>	Time:	<u>14:32:00</u>	
Removal Date:	<u>04/26/00</u>	Time:	<u>14:47:00</u>	
Total Exposure Time (h:m:s):	<u>00:15:00</u>	Weight of Sample After Exposure (mg):	<u>85.20</u>	
Weight Gain (mg):	<u>2.07</u>	Percent Weight Gain:	<u>2.49</u>	
Final Durometer Hardness After Desorption:	<u>76.1</u>	Percent Hardness Change:	<u>-1.0</u>	

Desorption Experiment

Mean Temperature of Desorption Experiment (setpoint = 30 deg C):	<u>30.000</u>	95% CL:	<u>0.0006</u>
Time Lapse Between Sample Exposure and Sample Desorption (sec):			<u>505</u>
Equilibrium Weight of Desorbed Sample at 30 deg C (mg):			<u>83.020</u>
Sample Extracted (mg):	<u>0.11</u>	Solubility Corrected for Extractables (mg):	<u>2.18</u>
Sample Extracted (%):	<u>0.13</u>	Solubility Corrected for Extractables (%):	<u>2.62</u>

Diffusion Coefficient Data: Fick's Law

High Concentration Diffusion Coefficient (cm ² /sec):	<u>2.1310E-07</u>
Range Including 0,1 Intercept, Relative Weight Fraction:	<u>1.00 - 0.62</u>
Linear Range of Desorption, Relative Weight Fraction:	<u>0.75 - 0.62</u>
Slope: <u>-1.1199E-02</u>	X-axis Intercept: <u>8.9294E+01</u>
R Square: <u>0.99947</u>	Y-axis Intercept: <u>9.9998E-01</u>
Low Concentration Diffusion Coefficient (cm ² /sec):	<u>1.1518E-10</u>
Linear Range of Desorption, Relative Weight Fraction:	<u>0.05 - 0.00</u>
Slope: <u>-2.6035E-04</u>	X-axis Intercept: <u>4.5669E+02</u>
R Square: <u>0.95361</u>	Y-axis Intercept: <u>1.1890E-01</u>

Wt. @ Zero Time, mg K 85.20	Wt. @ Zero Time, % L 2.490	Adjustment to TGA Time, sec M 505	Hardness Shore Scale N D
TGA Dry Wt., mg 83.130	Equil. Wt. Of Desorb. Sample 83.02	Min. Wt. Used For FDC, mg. 83.020	Pre Exposure Hardness 76.9
High Conc. DC, cm2/sec 2.1310E-07	Low Conc. DC, cm2/sec 1.1518E-10	Total Liquid Sorbed, mg. 2.070	Post Desorption Hardness 76.1
R Square 0.99947	R Square 0.95361		Change in Hardness, % -1.0
X Intercept 89.29	X Intercept 456.7		Mean Thickness, cm. 0.0930
Y Intercept 0.99998	Y Intercept 0.11890		
Y Intercept as Wt., mg. 85.198	X Intercept as Time, hrs. 57.9	X Intercept as Time, min. 347.6	pc0117d X Intercept as Time, days 2.4

TEMPERATURE STATISTICS

<i>Column1</i>		Max. TGA Wt., (orig data file) 84.665	TGA Wt. At 20 min. Adjustment 84.362
Mean	30.00019721	Sorption @ 7-12 min., mg	Sorption @ 20 min., mg
Standard Error	0.000308961	1.54	1.23
Median	30		
Mode	30	Sorption @ 7-12	Sorption @ 20
Standard Deviation	0.018874431	min., %	min., %
Sample Variance	0.000356244	1.85	1.48
Kurtosis	885.3566777		
Skewness	-24.1727843	Rel. Error (%) of	Rel. Error (%) of
Range	0.952	7-12 min. Sorp.	20 min. Sorp
Minimum	29.244	-25.8	-40.5
Maximum	30.196		
Sum	111960.736		
Count	3732		
Confidence Level(95.0%)	0.000605747		

HIGH CONCENTRATION DIFFUSION COEFFICIENT

pc0117d

SUMMARY OUTPUT

<i>Regression Statistics</i>	
Multiple R	0.999735807
R Square	0.999471684
Adjusted R Square	0.999447669
Standard Error	0.001800319
Observations	24

ANOVA

	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	1	0.134895688	0.134895688	41619.7136	1.50569E-37
Residual	22	7.13053E-05	3.24115E-06		
Total	23	0.134966994			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>
Intercept	0.999979835	0.001562048	640.1724278	1.7934E-48	0.996740343	1.003219327
X Variable 1	-0.011198696	5.48931E-05	-204.0091018	1.5057E-37	-0.011312537	-0.011084854

LOW CONCENTRATION DIFFUSION COEFFICIENT

SUMMARY OUTPUT

<i>Regression Statistics</i>	
Multiple R	0.976527763
R Square	0.953606472
Adjusted R Square	0.953561254
Standard Error	0.003773243
Observations	1028

ANOVA

	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	1	0.300253906	0.300253906	21089.1536	0
Residual	1026	0.014607533	1.42374E-05		
Total	1027	0.314861439			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>
Intercept	0.118901214	0.000694648	171.1674609	0	0.117538119	0.120264309
X Variable 1	-0.000260352	1.7928E-06	-145.221051	0	-0.00026387	-0.000256834

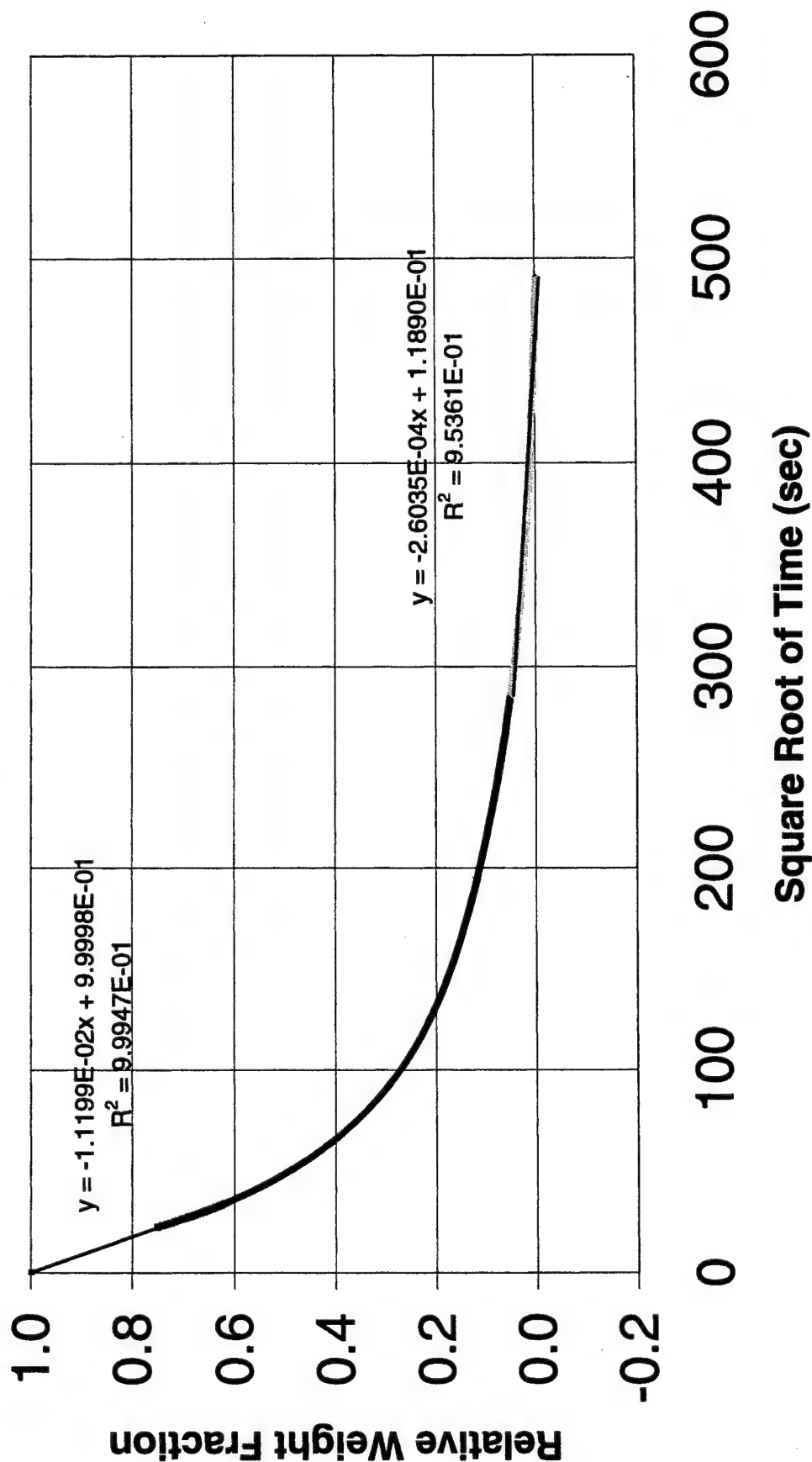
DIAMETER STATISTICS

<i>Column1</i>	
Mean	10.18
Standard Error	0.0391578
Median	10.19
Mode	#N/A
Standard Deviation	0.0783156
Sample Variance	0.00613333
Kurtosis	-0.768431
Skewness	-0.5995807
Range	0.18
Minimum	10.08
Maximum	10.26
Sum	40.72
Count	4
Confidence Level(95.0%)	0.12461771

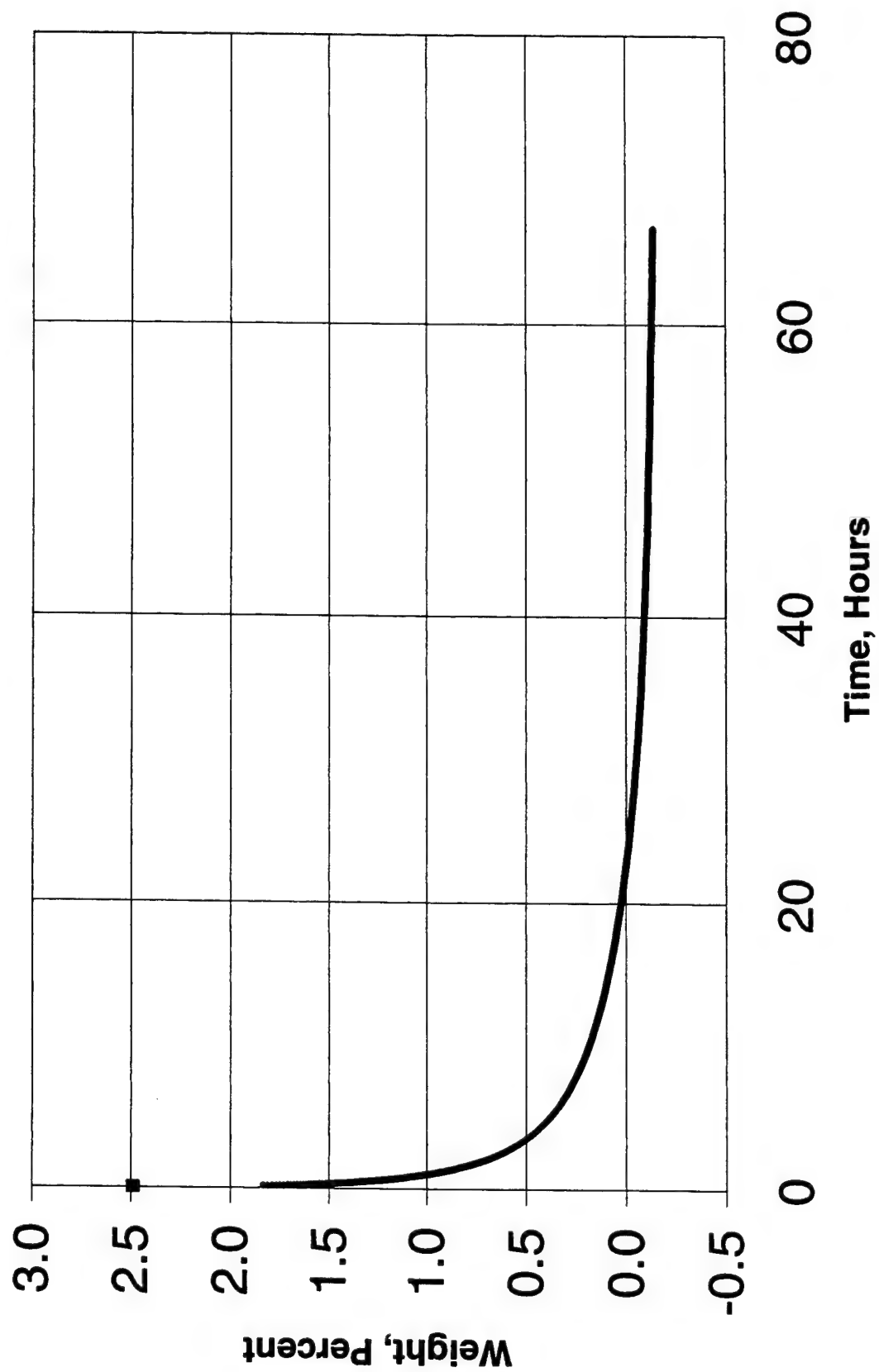
THICKNESS STATISTICS

<i>Column1</i>	
Mean	36.625
Standard Error	0.34247871
Median	36.4
Mode	#N/A
Standard Deviation	0.68495742
Sample Variance	0.46916667
Kurtosis	1.82944073
Skewness	1.46331586
Range	1.5
Minimum	36.1
Maximum	37.6
Sum	146.5
Count	4
Confidence Level(95.0%)	1.08992113

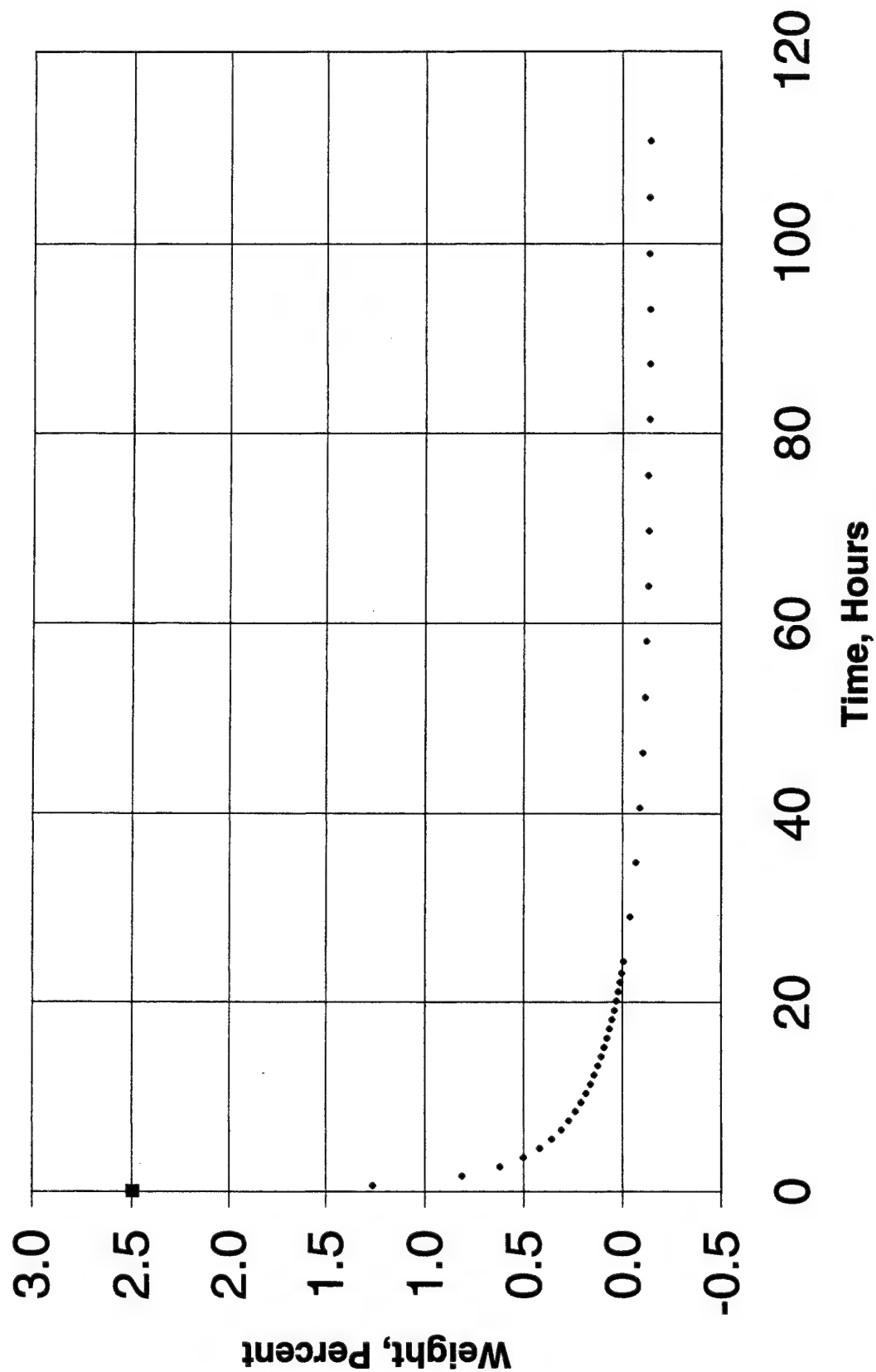
**Figure . Fick's Law Plot of Desorption Diffusion (30 degrees C)
of Supercritical Carbon Dioxide from Polymeric Materials:
PC (0117d)**



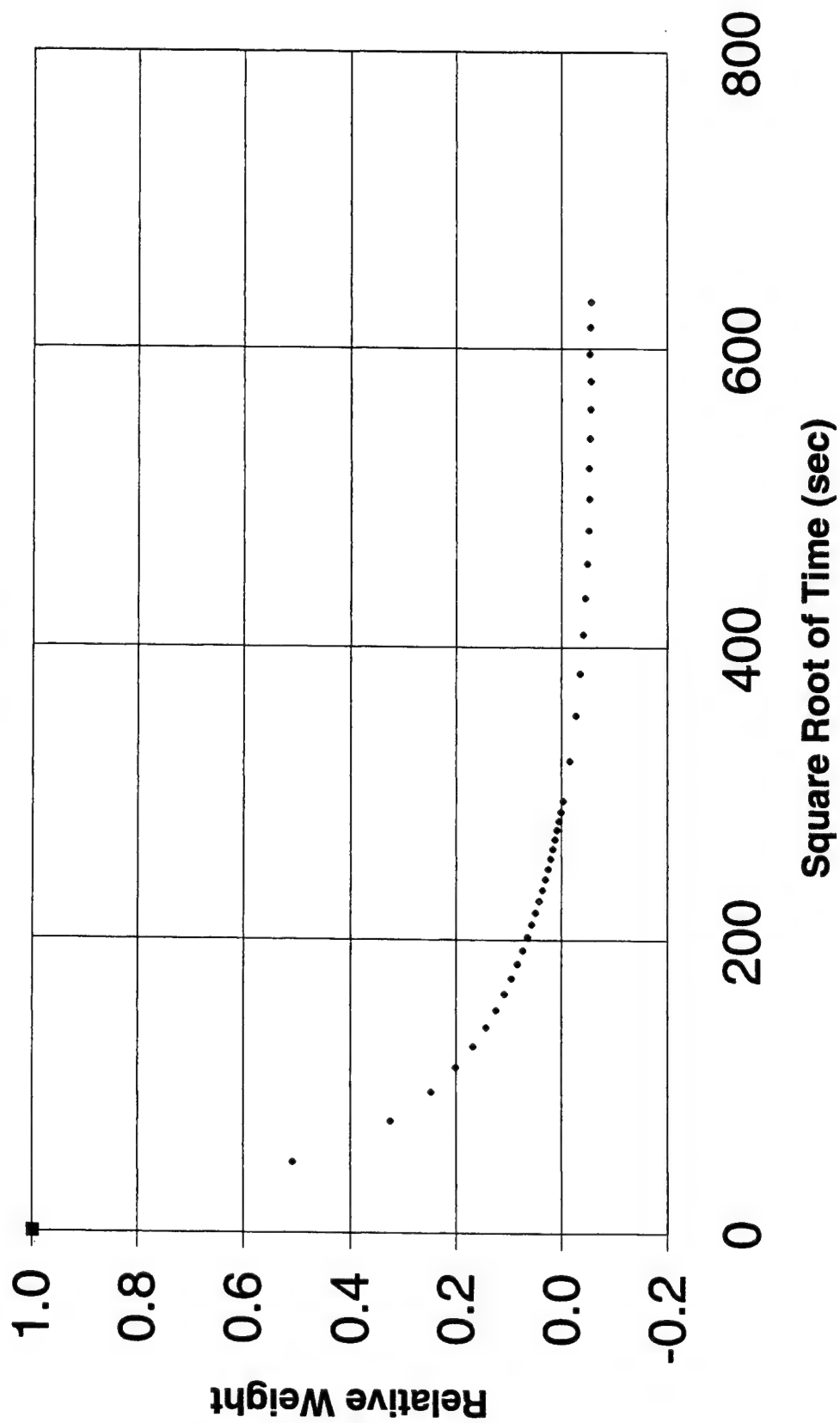
**Figure . Desorption Diffusion (30 degrees C) of Supercritical
Carbon Dioxide from Polymeric Materials: PC (0117d)**



**Figure . Desorption Diffusion (30 degrees C) of Supercritical
Carbon Dioxide from Polymeric Materials: PC (0117d)**



**Figure . Fick's Law Plot of Desorption Diffusion (30 degrees C) of
Supercritical Carbon Dioxide from Polymeric Materials:
PC (0117d)**



TGA Time, min	Temp., deg C	TGA Wt., mg	TGA Time, sec	Adjusted Time, sec	Adjusted Time, hr	SQRT Adj. Time, sec	Wt. Loss, %	Fractional Wt. Loss	Wt. @ Zero Time, mg	Wt. @ Zero Time, %	TGA Dry Wt., mg	Adjustment to TGA Time, sec	Hardness Scale
A	B	C	D	E	F	G	H	I	J	K	L	M	N
29.083	29.992	84.177	1744.980	2249.980	0.625	47.43	1.265	0.507	85.20	2.496	83.125	505	Shore D
87.426	30.001	83.800	5245.560	5750.560	1.597	75.83	0.812	0.325					
145.791	30.000	83.640	8747.460	9252.460	2.570	96.19	0.619	0.248					
204.208	30.001	83.543	12252.480	12757.480	3.544	112.95	0.502	0.201					
262.620	30.000	83.475	15757.200	16262.200	4.517	127.52	0.421	0.169					
321.006	30.000	83.424	19260.360	19765.360	5.490	140.59	0.360	0.144					
379.389	30.000	83.384	22763.340	23268.340	6.463	152.54	0.312	0.125					
437.756	30.000	83.352	26265.360	26770.360	7.436	163.62	0.273	0.109					
496.161	30.000	83.324	29769.660	30274.660	8.410	174.00	0.240	0.096					
554.564	30.000	83.301	33273.840	33778.840	9.383	183.79	0.211	0.085					
613.002	30.000	83.279	36780.120	37285.120	10.357	193.09	0.186	0.074					
671.416	30.000	83.261	40284.960	40789.960	11.331	201.97	0.163	0.065					
729.803	30.000	83.244	43788.180	44293.180	12.304	210.46	0.143	0.057					
788.223	30.000	83.229	47293.380	47798.380	13.277	218.63	0.125	0.050					
846.650	30.000	83.215	50799.000	51304.000	14.251	226.50	0.108	0.043					
905.022	30.000	83.202	54301.320	54806.320	15.224	234.11	0.093	0.037					
963.398	30.001	83.190	57803.880	58308.880	16.197	241.47	0.079	0.031					
1021.827	30.000	83.179	61309.620	61814.620	17.171	248.63	0.065	0.026					
1080.231	30.000	83.169	64813.860	65318.860	18.144	255.58	0.053	0.021					
1138.601	30.000	83.160	68316.060	68821.060	19.117	262.34	0.042	0.017					
1196.965	30.000	83.151	71817.900	72322.900	20.090	268.93	0.031	0.013					
1255.317	30.000	83.143	75319.020	75824.020	21.062	275.36	0.022	0.009					
1313.713	30.001	83.135	78822.780	79327.780	22.035	281.65	0.012	0.005					
1372.081	30.000	83.128	82324.860	82829.860	23.008	287.80	0.003	0.001					
1445.169	30.000	83.119	86710.140	87215.140	24.226	295.32	-0.007	-0.003					
1727.199	30.000	83.093	103631.940	104136.940	28.927	322.70	-0.039	-0.015					
2077.226	30.000	83.069	124633.560	125138.560	34.761	353.75	-0.068	-0.027					
2427.234	30.000	83.052	145634.040	146139.040	40.594	382.28	-0.088	-0.035					
2777.250	30.000	83.040	166635.000	167140.000	46.428	408.83	-0.102	-0.041					
3127.286	30.002	83.032	187637.160	188142.160	52.262	433.75	-0.112	-0.045					
3477.314	30.002	83.024	208638.840	209143.840	58.096	457.32	-0.121	-0.049					
3827.326	30.002	83.018	229639.560	230144.560	63.929	479.73	-0.129	-0.052					
4177.356	30.000	83.016	250641.360	251146.360	69.763	501.15	-0.132	-0.053					
4527.365	30.000	83.018	271641.900	272146.900	75.596	521.68	-0.129	-0.052					
4877.375	30.003	83.012	292642.500	293147.500	81.430	541.43	-0.136	-0.055					
5227.378	30.001	83.010	313642.680	314147.680	87.263	560.49	-0.139	-0.056					
5577.400	30.000	83.009	334644.000	335149.000	93.097	578.92	-0.139	-0.056					
5927.443	30.000	83.013	355646.580	356151.580	98.931	596.78	-0.135	-0.054					
6277.470	30.003	83.011	376648.200	377153.200	104.765	614.13	-0.138	-0.055					
6627.492	30.002	83.007	397649.520	398154.520	110.598	630.99	-0.142	-0.057					

Formulae Used for Analysis of Data
 Uppercase letters refer to columns
 Lowercase n refers to row, beginning with n=4

 Dn = (An * 60)
 En = (Dn + M4)
 Fn = (En / 3600)
 Gn = SQRT (En)
 Hn = (((Cn - L4) / L4) * 100)
 In = ((Cn - L4) / (J4 - L4))
 K4 = (((J4 - L4) / L4) * 100)
 N16 = (((N12 - N8) / N8) * 100)

 Source binary TA data file : pc0117d.01
 14 lines in the parameter block
 3 channels of data

 Run 33
 Module TGA Aluminum Pans
 Sample PC SCCO2 0117D
 Size 84.665 mg
 Method DESORPTION-Isothermal
 Operator BSI
 Comment Disk: 4x0.03in., HP@1400x50, Dry: TG-83.125 M-82.96 ET: 8:15
 Nsig 3
 Sig1 Time (min)
 Sig2 Temperature (°C)
 Sig3 Weight (mg)
 Kcell 1.0000
 Date 26-Apr-00
 Time 14:56

Blank

FIGURE . CHEMICAL-MATERIAL INTERACTION DATA SET:
Supercritical Carbon Dioxide and Polymethyl Methacrylate PMMA
Sorption, Desorption Diffusion, and Indentation Data Sets

Material Data

Test Reference Number:	<u>01-1-2</u>	TGA Filename:	<u>pmma105z</u>
Property Test Specification:	ASTM D471/D543		
Material Name:	<u>Polymethyl Methacrylate</u>	Material Code:	<u>PMMA</u>
Material Supplier:	<u>Harbor City Plastics</u>	Material Class:	<u>TP</u>
Monomer Source:	<u>Rohm & Haas</u>	Base Polymer (Lot. No.):	<u>Plexiglass (76B818)</u>
Exposure Liquid:	<u>Supercritical Carbon Dioxide</u>	Replicate Number:	<u>2</u>

Pre-Exposure Data

Measured Diameter (mm):	<u>10.41</u>	<u>10.42</u>	<u>10.44</u>	<u>10.43</u>	
Mean Diameter:	<u>10.425</u>				95% Confidence Level (CL): <u>0.021</u>
Measured Thickness (mils):	<u>38.30</u>	<u>39.40</u>	<u>39.40</u>	<u>39.00</u>	
Mean Thickness:	<u>39.025</u>				95% Confidence Level (CL): <u>0.826</u>
Initial Sample Weight (mg):	<u>91.020</u>				
Initial Durometer Hardness:	<u>82.0</u>	Scale: SHORE	<u>D</u>		

Sample Exposure Data

Exposure Date:	<u>04/14/00</u>	Time:	<u>09:50:00</u>	
Removal Date:	<u>04/14/00</u>	Time:	<u>10:05:00</u>	
Total Exposure Time (h:m:s):	<u>00:15:00</u>	Weight of Sample After Exposure (mg):	<u>96.70</u>	
Weight Gain (mg):	<u>5.68</u>	Percent Weight Gain:	<u>6.24</u>	
Final Durometer Hardness After Desorption:	<u>81.0</u>	Percent Hardness Change:	<u>-1.2</u>	

Desorption Experiment

Mean Temperature of Desorption Experiment (setpoint = 30 deg C):	<u>30.000</u>	95% CL:	<u>0.0006</u>
Time Lapse Between Sample Exposure and Sample Desorption (sec):			<u>480</u>
Equilibrium Weight of Desorbed Sample at 30 deg C (mg):			<u>91.220</u>
Sample Extracted (mg):	<u>-0.20</u>	Solubility Corrected for Extractables (mg):	<u>5.68</u>
Sample Extracted (%):	<u>-0.22</u>	Solubility Corrected for Extractables (%):	<u>6.24</u>

Diffusion Coefficient Data: Fick's Law

High Concentration Diffusion Coefficient (cm ² /sec):	<u>9.6726E-08</u>
Range Including Intercept (0,1), Relative Weight Fraction:	<u>1.00 - 0.70</u>
Linear Range of Desorption, Relative Weight Fraction:	<u>0.84 - 0.70</u>
Slope:	<u>-7.0808E-03</u>
X-axis Intercept:	<u>1.4056E+02</u>
R Square:	<u>0.99879</u>
Y-axis Intercept:	<u>9.9531E-01</u>
Low Concentration Diffusion Coefficient (cm ² /sec):	<u>1.6240E-10</u>
Linear Range of Desorption, Relative Weight Fraction:	<u>0.07 - 0.04</u>
Slope:	<u>-2.9014E-04</u>
X-axis Intercept:	<u>6.8436E+02</u>
R Square:	<u>0.98778</u>
Y-axis Intercept:	<u>1.9856E-01</u>

Wt. @ Zero Time, mg K 96.70	Wt. @ Zero Time, % L 6.240	Adjustment to TGA Time, sec M 480	Hardness Shore Scale N D
TGA Dry Wt., mg 91.020	Equil. Wt. Of Desorb. Sample 91.22	Min. Wt. Used For FDC, mg. 91.020	Pre Exposure Hardness 82.0
High Conc. DC, cm2/sec 9.6726E-08	Low Conc. DC, cm2/sec 1.6240E-10	Total Liquid Sorbed, mg. 5.680	Post Desorption Hardness 81.0
R Square 0.99879	R Square 0.98778		Change in Hardness, % -1.2
X Intercept 140.56	X Intercept 684.4		Mean Thickness, cm. 0.0991
Y Intercept 0.99531	Y Intercept 0.19856		
Y Intercept as Wt., mg. 96.246	X Intercept as Time, hrs. 130.1	X Intercept as Time, min. 780.6	pmma105z X Intercept as Time, days 5.4

TEMPERATURE STATISTICS

<i>Column1</i>		Max. TGA Wt., (orig data file) 95.811	TGA Wt. At 20 min. Adjustment 95.271
Mean	30.00010643	Sorption @ 7-12 min., mg	Sorption @ 20 min., mg
Standard Error	0.000290767	4.79	4.25
Median	30		
Mode	29.999	Sorption @ 7-12 min., %	Sorption @ 20 min., %
Standard Deviation	0.018843886	5.26	4.67
Sample Variance	0.000355092		
Kurtosis	633.726776	Rel. Error (%) of 7-12 min. Sorp.	Rel. Error (%) of 20 min. Sorp
Skewness	-15.92093413	-15.7	-25.2
Range	0.948		
Minimum	29.304		
Maximum	30.252		
Sum	126000.447		
Count	4200		
Confidence Level(95.0%)	0.000570058		

HIGH CONCENTRATION DIFFUSION COEFFICIENT

pmma105z

SUMMARY OUTPUT

<i>Regression Statistics</i>	
Multiple R	0.999392912
R Square	0.998786192
Adjusted R Square	0.998757963
Standard Error	0.001910724
Observations	45

ANOVA

	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	1	0.129177474	0.129177474	35382.6889	2.46696E-64
Residual	43	0.000156987	3.65087E-06		
Total	44	0.129334462			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>
Intercept	0.995306197	0.001254388	793.4594157	3.3271E-91	0.992776484	0.99783591
X Variable 1	-0.007080764	3.7643E-05	-188.1028679	2.467E-64	-0.007156678	-0.00700485

LOW CONCENTRATION DIFFUSION COEFFICIENT

SUMMARY OUTPUT

<i>Regression Statistics</i>	
Multiple R	0.993869749
R Square	0.987777077
Adjusted R Square	0.987758669
Standard Error	0.001092044
Observations	666

ANOVA

	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	1	0.063992957	0.063992957	53660.1588	0
Residual	664	0.00079186	1.19256E-06		
Total	665	0.064784817			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>
Intercept	0.198557182	0.000644294	308.1780092	0	0.197292082	0.199822282
X Variable 1	-0.000290135	1.25249E-06	-231.6466247	0	-0.000292594	-0.000287676

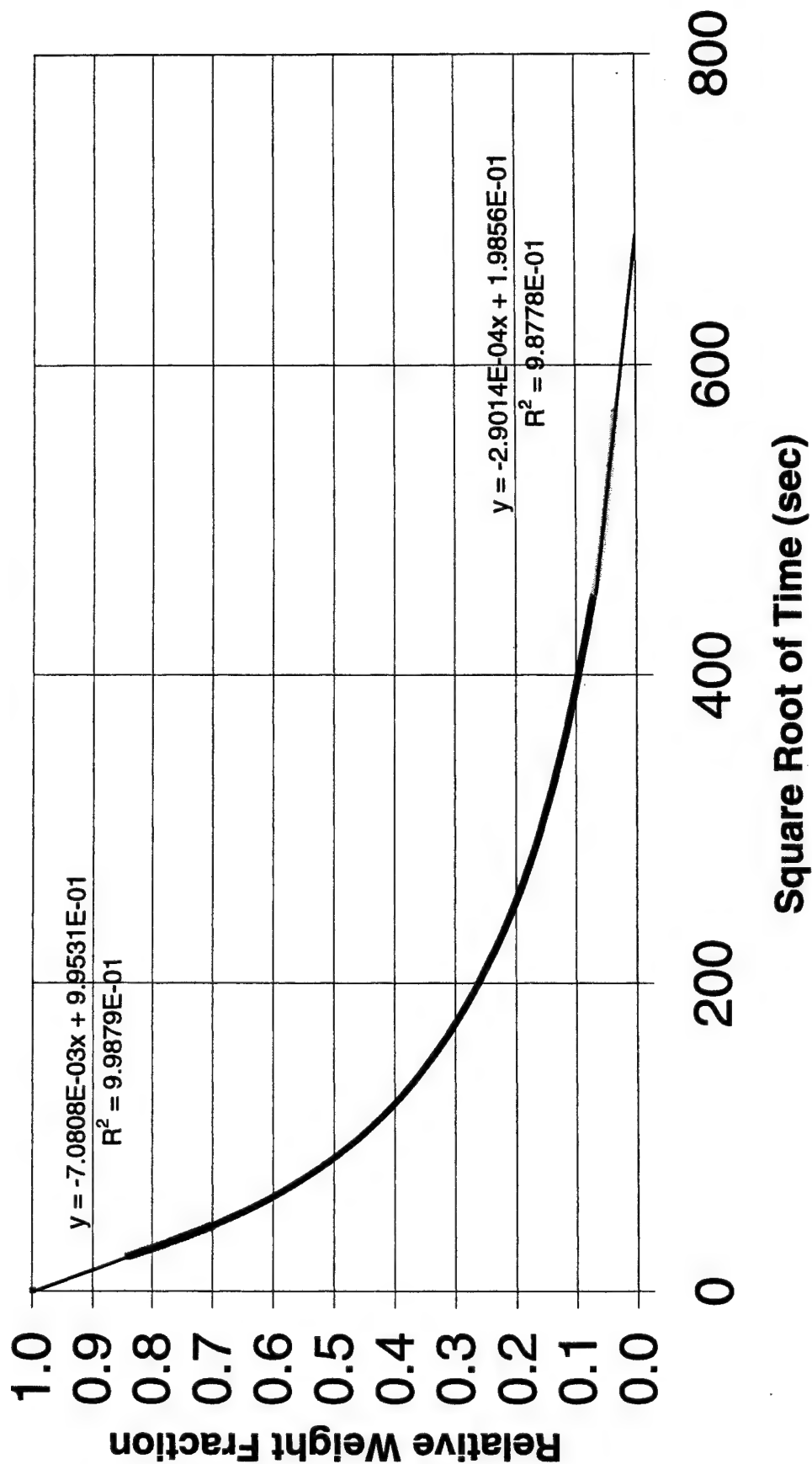
DIAMETER STATISTICS

<i>Column1</i>	
Mean	10.425
Standard Error	0.00645497
Median	10.425
Mode	#N/A
Standard Deviation	0.01290994
Sample Variance	0.00016667
Kurtosis	-1.2
Skewness	4.1231E-13
Range	0.03
Minimum	10.41
Maximum	10.44
Sum	41.7
Count	4
Confidence Level(95.0%)	0.02054262

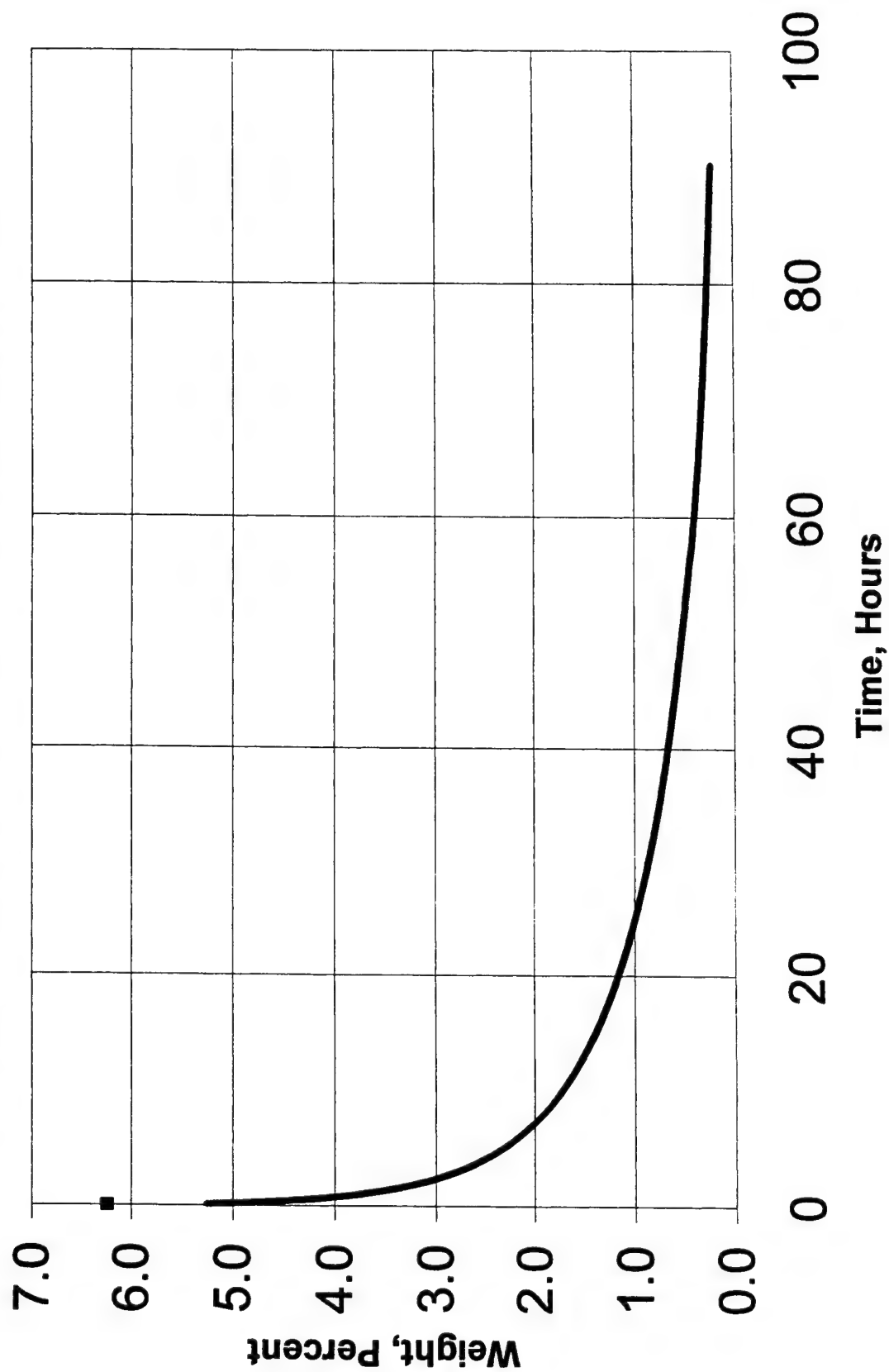
THICKNESS STATISTICS

<i>Column1</i>	
Mean	39.025
Standard Error	0.25940637
Median	39.2
Mode	39.4
Standard Deviation	0.51881275
Sample Variance	0.26916667
Kurtosis	1.030931
Skewness	-1.3158168
Range	1.1
Minimum	38.3
Maximum	39.4
Sum	156.1
Count	4
Confidence Level(95.0%)	0.82554763

**Figure . Fick's Law Plot of Desorption Diffusion (30 degrees C)
of Supercritical Carbon Dioxide from Polymeric Materials:
PMMA (105z)**



**Figure . Desorption Diffusion (30 degrees C) of Supercritical
Carbon Dioxide from Polymeric Materials: PMMA (105z)**



**Figure . Desorption Diffusion (30 degrees C) of Supercritical
Carbon Dioxide from Polymeric Materials: PMMA (105z)**

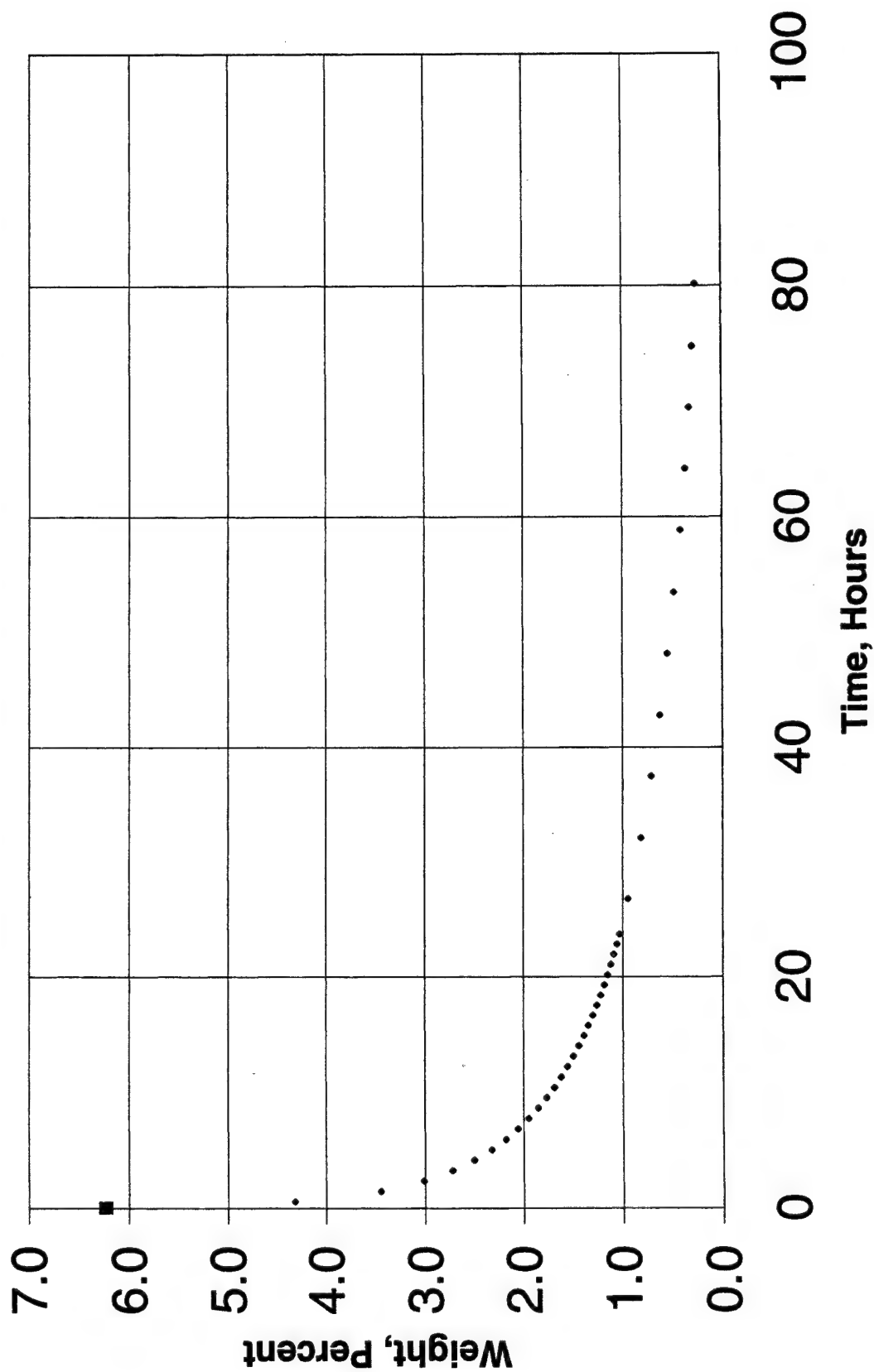
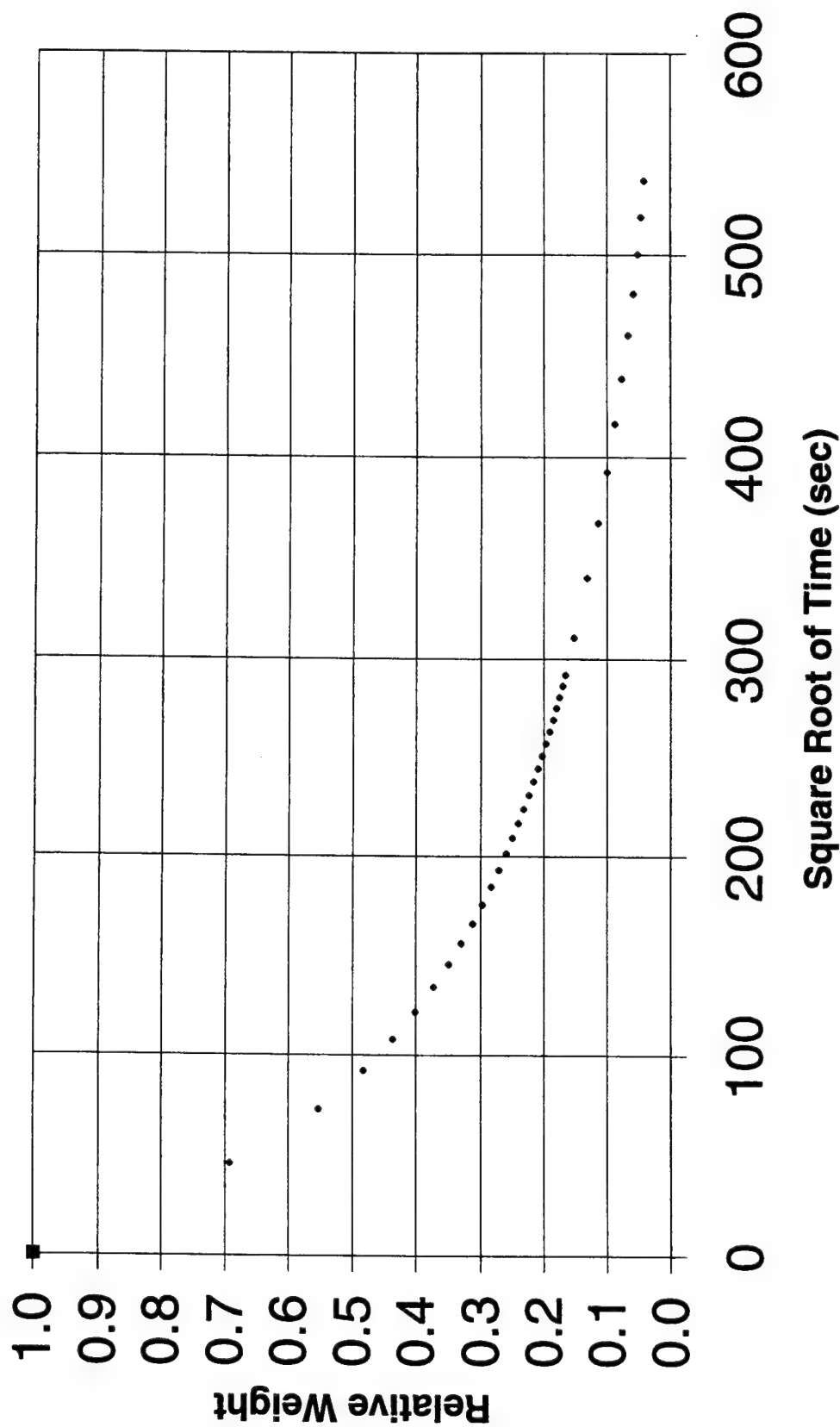


Figure . Fick's Law Plot of Desorption Diffusion (30 degrees C) of Supercritical Carbon Dioxide from Polymeric Materials: PMMA (105z)



TGA Time, min	Temp., deg C	TGA Wt., mg	TGA Time, sec	Adjusted Time, sec	Adjusted Time, hr	SQRT Adj. Time, sec	Wt. Loss, %	Fractional Wt. Loss	Wt. @ Zero Time, mg	Wt. @ Zero Time, %	TGA Dry Wt., mg	Adjustment to TGA Time, sec	Hardness Scale
A	B	C	D	E	F	G	H	I	J	K	L	M	N
26.605	29.999	94.957	1596.300	2076.300	0.577	45.57	4.323	0.693	96.70	6.238	91.022	480	Shore D
79.973	30.000	94.162	4798.380	5278.380	1.466	72.65	3.450	0.553					
133.333	30.000	93.765	7999.980	8479.980	2.356	92.09	3.014	0.483					
186.679	30.000	93.499	11200.740	11680.740	3.245	108.08	2.721	0.436					
240.073	30.000	93.298	14404.380	14884.380	4.135	122.00	2.501	0.401					
293.439	30.000	93.139	17606.340	18086.340	5.024	134.49	2.326	0.373					
346.831	30.000	93.007	20809.860	21289.860	5.914	145.91	2.181	0.350					
400.198	30.000	92.895	24011.880	24491.880	6.803	156.50	2.058	0.330					
453.559	30.000	92.796	27213.540	27693.540	7.693	166.41	1.949	0.313					
506.966	30.000	92.709	30414.360	30894.360	8.582	175.77	1.853	0.297					
560.272	30.000	92.632	33616.320	34096.320	9.471	184.65	1.769	0.284					
613.652	30.000	92.563	36819.120	37299.120	10.361	193.13	1.693	0.271					
667.059	30.000	92.499	40023.540	40503.540	11.251	201.25	1.623	0.260					
720.461	30.000	92.442	43227.660	43707.660	12.141	209.06	1.560	0.250					
773.847	30.000	92.389	46430.820	46910.820	13.031	216.59	1.502	0.241					
827.254	30.000	92.339	49635.240	50115.240	13.921	223.86	1.447	0.232					
880.620	30.000	92.294	52837.200	53317.200	14.810	230.91	1.397	0.224					
933.985	30.000	92.251	56039.100	56519.100	15.700	237.74	1.350	0.216					
987.347	30.000	92.211	59240.820	59720.820	16.589	244.38	1.306	0.209					
1040.723	30.000	92.174	62443.380	62923.380	17.479	250.85	1.265	0.203					
1094.104	30.000	92.139	65646.240	66126.240	18.368	257.15	1.228	0.197					
1147.511	30.000	92.106	68850.660	69330.660	19.259	263.31	1.191	0.191					
1200.894	30.000	92.075	72053.640	72533.640	20.148	269.32	1.157	0.185					
1254.264	30.000	92.045	75255.840	75735.840	21.038	275.20	1.124	0.180					
1307.687	30.000	92.017	78461.220	78941.220	21.928	280.96	1.093	0.175					
1361.055	30.000	91.989	81663.300	82143.300	22.818	286.61	1.063	0.170					
1414.413	30.000	91.964	84864.780	85344.780	23.707	292.14	1.035	0.166					
1601.095	30.000	91.885	96065.700	96545.700	26.818	310.72	0.948	0.152					
1921.123	30.000	91.767	115267.380	115747.380	32.152	340.22	0.818	0.131					
2241.156	30.000	91.670	134469.360	134949.360	37.486	367.35	0.711	0.114					
2561.181	30.000	91.589	153670.860	154150.860	42.820	392.62	0.623	0.100					
2881.187	30.000	91.521	172871.220	173351.220	48.153	416.35	0.548	0.088					
3201.232	30.000	91.459	192073.920	192553.920	53.487	438.81	0.480	0.077					
3521.241	30.000	91.400	211274.460	211754.460	58.821	460.17	0.416	0.067					
3841.253	30.000	91.354	230475.180	230955.180	64.154	480.58	0.365	0.058					
4161.287	30.000	91.317	249677.220	250157.220	69.488	500.16	0.324	0.052					
4481.306	30.000	91.287	268878.360	269358.360	74.822	519.00	0.291	0.047					
4801.333	30.000	91.261	288079.980	288559.980	80.156	537.18	0.263	0.042					

Formulae Used for Analysis of Data

Uppercase letters refer to columns

Lowercase n refers to row, beginning with n=4

Dn = (An * 60)

En = (Dn + M4)

Fn = (En / 3600)

Gn = SQRT (En)

Hn = (((Cn - L4) / L4) * 100)

In = (((Cn - L4) / (J4 - L4))

K4 = (((J4 - L4) / L4) * 100)

N16 = (((N12 - N8) / N8) * 100)

Source binary TA data file : pmma105z.01

14 lines in the parameter block

3 channels of data

Run 28

Module TGA Aluminum Pans

Sample PMMA SCO2 PMMA105Z

Size 95.811 mg

Method DESORPTION-Isothermal

Operator WJS

Comment Disk: .4x0.03 in. HP@1400x50, DRY: TG: 91.022, M: 91.20 ET:8.00

Nsig 3

Sig1 Time (min)

Sig2 Temperature (°C)

Sig3 Weight (mg)

Kcell 1.0000

Date 14-Apr-00

Time 10:13

Blank

FIGURE . CHEMICAL-MATERIAL INTERACTION DATA SET:**Supercritical Carbon Dioxide and Polymethyl Methacrylate****PMMA****Sorption, Desorption Diffusion, and Indentation Data Sets****Material Data**

Test Reference Number:	<u>01-1-1</u>	TGA Filename:	<u>pmma075z</u>
Property Test Specification:	ASTM D471/D543		
Material Name:	<u>Polymethyl Methacrylate</u>	Material Code:	<u>PMMA</u>
Material Supplier:	<u>Harbor City Plastics</u>	Material Class:	<u>TP</u>
Monomer Source:	<u>Rohm & Haas</u>	Base Polymer (Lot. No.):	<u>Plexiglass (76B818)</u>
Exposure Liquid:	<u>Supercritical Carbon Dioxide</u>	Replicate Number:	<u>1</u>

Pre-Exposure Data

Measured Diameter (mm):	<u>10.41</u>	<u>10.32</u>	<u>10.29</u>	<u>10.30</u>	
Mean Diameter:	<u>10.330</u>				95% Confidence Level (CL): <u>0.087</u>
Measured Thickness (mils):	<u>38.30</u>	<u>38.90</u>	<u>38.20</u>	<u>38.20</u>	
Mean Thickness:	<u>38.400</u>				95% Confidence Level (CL): <u>0.536</u>
Initial Sample Weight (mg):	<u>90.900</u>				
Initial Durometer Hardness:	<u>80.2</u>	Scale: SHORE	<u>D</u>		

Sample Exposure Data

Exposure Date:	<u>03/15/00</u>	Time:	<u>11:12:00</u>	
Removal Date:	<u>03/15/00</u>	Time:	<u>11:27:00</u>	
Total Exposure Time (h:m:s):	<u>00:15:00</u>	Weight of Sample After Exposure (mg):	<u>96.20</u>	
Weight Gain (mg):	<u>5.30</u>	Percent Weight Gain:	<u>5.83</u>	
Final Durometer Hardness After Desorption:	<u>79.5</u>	Percent Hardness Change:	<u>-0.9</u>	

Desorption Experiment

Mean Temperature of Desorption Experiment (setpoint = 30 deg C):	<u>30.000</u>	95% CL:	<u>0.0012</u>
Time Lapse Between Sample Exposure and Sample Desorption (sec):			<u>480</u>
Equilibrium Weight of Desorbed Sample at 30 deg C (mg):			<u>91.720</u>
Sample Extracted (mg):	<u>-0.82</u>	Solubility Corrected for Extractables (mg):	<u>5.30</u>
Sample Extracted (%):	<u>-0.90</u>	Solubility Corrected for Extractables (%):	<u>5.83</u>

Diffusion Coefficient Data: Fick's Law

High Concentration Diffusion Coefficient (cm ² /sec):	<u>9.5093E-08</u>
Range Including Intercept (0,1), Relative Weight Fraction:	<u>1.00 - 0.70</u>
Linear Range of Desorption, Relative Weight Fraction:	<u>0.84 - 0.70</u>
Slope:	<u>-7.1350E-03</u>
X-axis Intercept:	<u>1.3810E+02</u>
R Square:	<u>0.99602</u>
Y-axis Intercept:	<u>9.8532E-01</u>

Low Concentration Diffusion Coefficient (cm ² /sec):	<u>1.8087E-09</u>
Linear Range of Desorption, Relative Weight Fraction:	<u>0.20 - 0.15</u>
Slope:	<u>-9.8402E-04</u>
X-axis Intercept:	<u>4.4025E+02</u>
R Square:	<u>0.99931</u>
Y-axis Intercept:	<u>4.3322E-01</u>

Wt. @ Zero Time, mg K 96.20	Wt. @ Zero Time, % L 5.831	Adjustment to TGA Time, sec M 480	Hardness Shore Scale N D
TGA Dry Wt., mg 90.90	Equil. Wt. Of Desorb. Sample 91.72	Min. Wt. Used For FDC, mg. 90.90	Pre Exposure Hardness 80.2
High Conc. DC, cm2/sec 9.5093E-08	Low Conc. DC, cm2/sec 1.8087E-09	Total Liquid Sorbed, mg. 5.300	Post Desorption Hardness 79.5
R Square 0.99602	R Square 0.99931		Change in Hardness, % -0.9
X Intercept 138.10	X Intercept 440.3		Mean Thickness, cm. 0.0975
Y Intercept 0.98532	Y Intercept 0.43322		
Y Intercept as Wt., mg. 94.788	X Intercept as Time, hrs. 53.8	X Intercept as Time, min. 323.0	pmma075z X Intercept as Time, days 2.2

TEMPERATURE STATISTICS

<i>Column1</i>		Max. TGA Wt., (orig data file) 95.283	TGA Wt. At 20 min. Adjustment 94.810
Mean	30.00002503	Sorption @ 7-12 min., mg	Sorption @ 20 min., mg
Standard Error	0.000611564	4.38	3.91
Median	30		
Mode	30	Sorption @ 7-12	Sorption @ 20
Standard Deviation	0.031642147	min., %	min., %
Sample Variance	0.001001225	4.82	4.30
Kurtosis	388.3126273		
Skewness	-12.72037019	Rel. Error (%) of	Rel. Error (%) of
Range	1.251	7-12 min. Sorp.	20 min. Sorp
Minimum	29.078	-17.3	-26.2
Maximum	30.329		
Sum	80310.067		
Count	2677		
Confidence Level(95.0%)	0.001199186		

HIGH CONCENTRATION DIFFUSION COEFFICIENT

pmma075z

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.998007353
R Square	0.996018676
Adjusted R Square	0.995916591
Standard Error	0.003392701
Observations	41

ANOVA

	df	SS	MS	F	Significance F
Regression	1	0.112304144	0.112304144	9756.73689	2.01829E-48
Residual	39	0.000448906	1.15104E-05		
Total	40	0.11275305			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	0.985321378	0.002340215	421.0388357	6.0118E-73	0.980587851	0.990054905
X Variable 1	-0.007135014	7.22341E-05	-98.77619599	2.0183E-48	-0.007281121	-0.006988907

LOW CONCENTRATION DIFFUSION COEFFICIENT

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.999653993
R Square	0.999308105
Adjusted R Square	0.999307256
Standard Error	0.000351402
Observations	817

ANOVA

	df	SS	MS	F	Significance F
Regression	1	0.145353831	0.145353831	1177109.34	0
Residual	815	0.000100639	1.23484E-07		
Total	816	0.14545447			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	0.433216228	0.000237547	1823.708373	0	0.432749951	0.433682504
X Variable 1	-0.000984018	9.06974E-07	-1084.946701	0	-0.000985798	-0.000982238

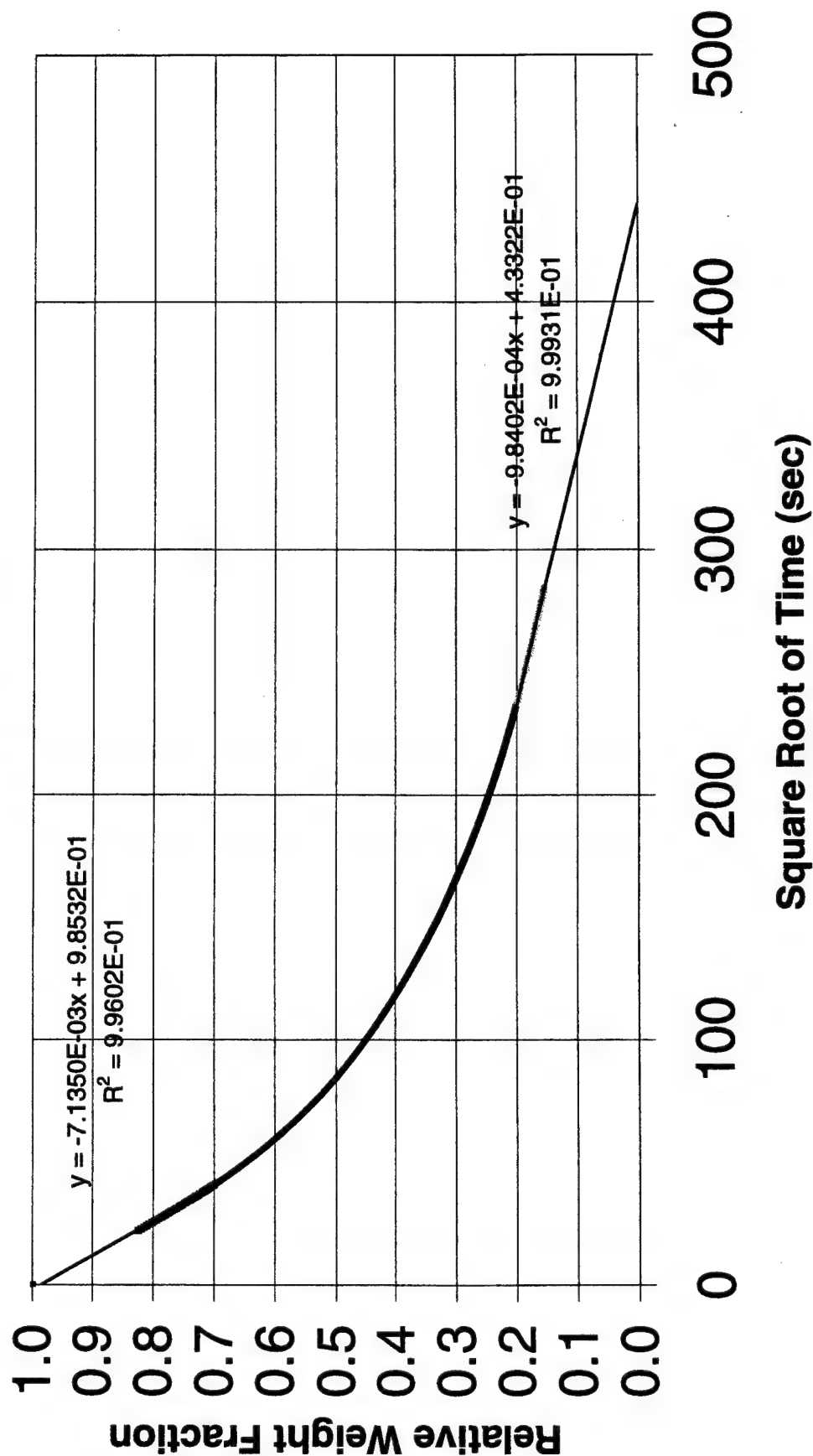
DIAMETER STATISTICS

<i>Column1</i>	
Mean	10.33
Standard Error	0.02738613
Median	10.31
Mode	#N/A
Standard Deviation	0.05477226
Sample Variance	0.003
Kurtosis	2.92222222
Skewness	1.70402573
Range	0.12
Minimum	10.29
Maximum	10.41
Sum	41.32
Count	4
Confidence Level(95.0%)	0.08715496

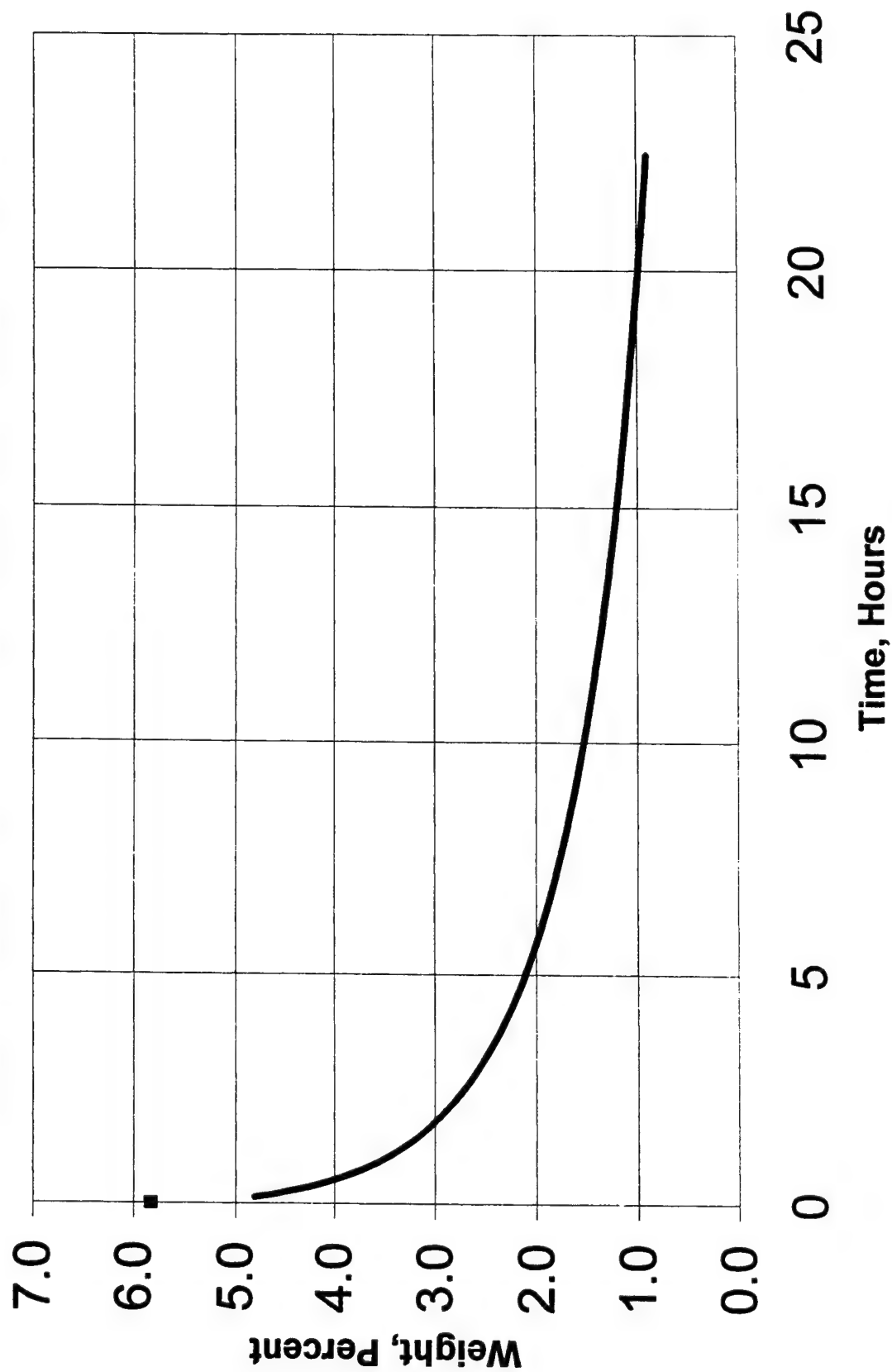
THICKNESS STATISTICS

<i>Column1</i>	
Mean	38.4
Standard Error	0.16832508
Median	38.25
Mode	38.2
Standard Deviation	0.33665016
Sample Variance	0.11333333
Kurtosis	3.57612457
Skewness	1.88710473
Range	0.7
Minimum	38.2
Maximum	38.9
Sum	153.6
Count	4
Confidence Level(95.0%)	0.53568604

**Figure . Fick's Law Plot of Desorption Diffusion (30 degrees C)
of Supercritical Carbon Dioxide from Polymeric Materials:
PMMA (075z)**



**Figure . Desorption Diffusion (30 degrees C) of Supercritical
Carbon Dioxide from Polymeric Materials: PMMA (075z)**



**Figure . Desorption Diffusion (30 degrees C) of Supercritical
Carbon Dioxide from Polymeric Materials: PMMA (075z)**

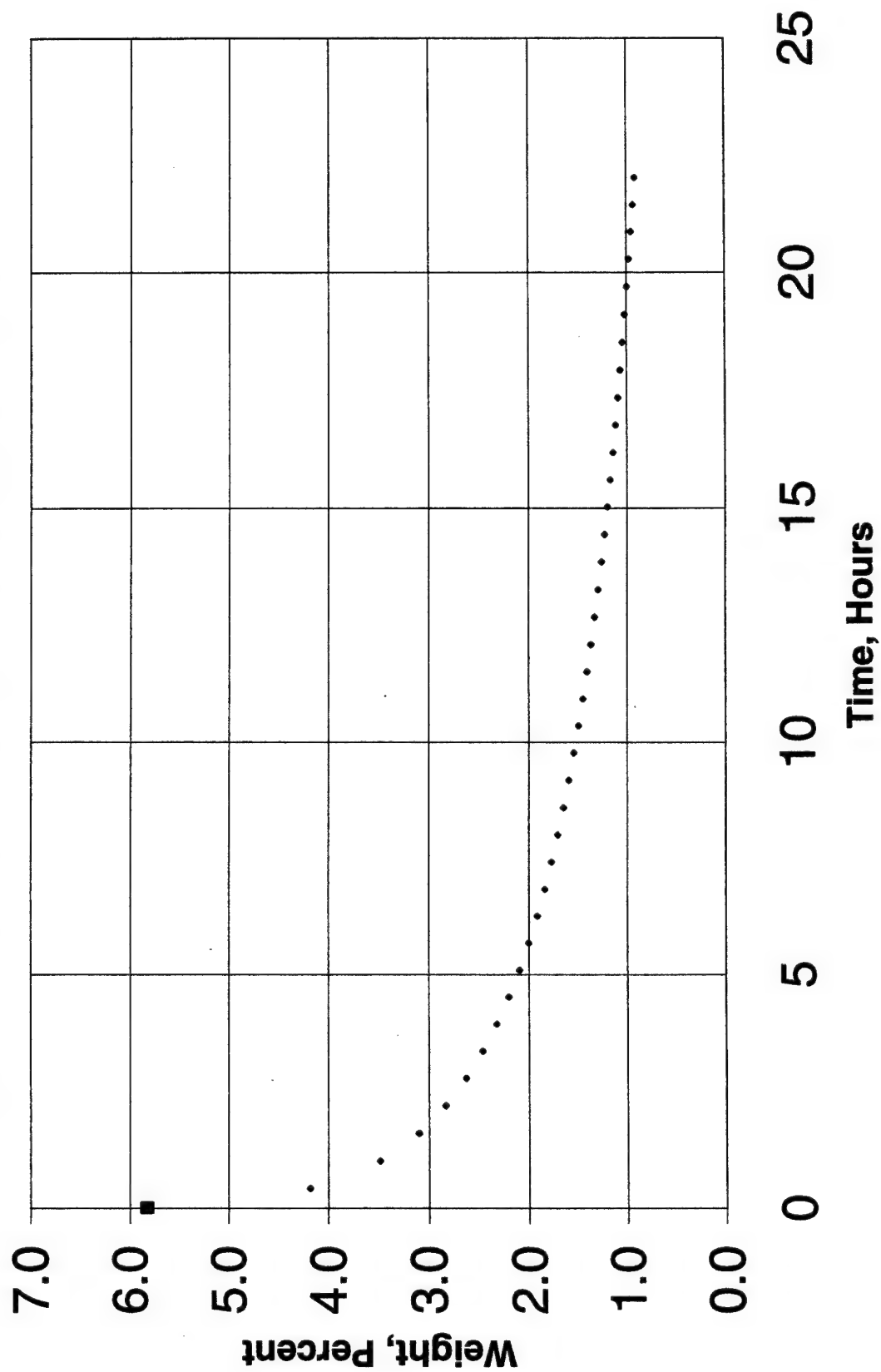
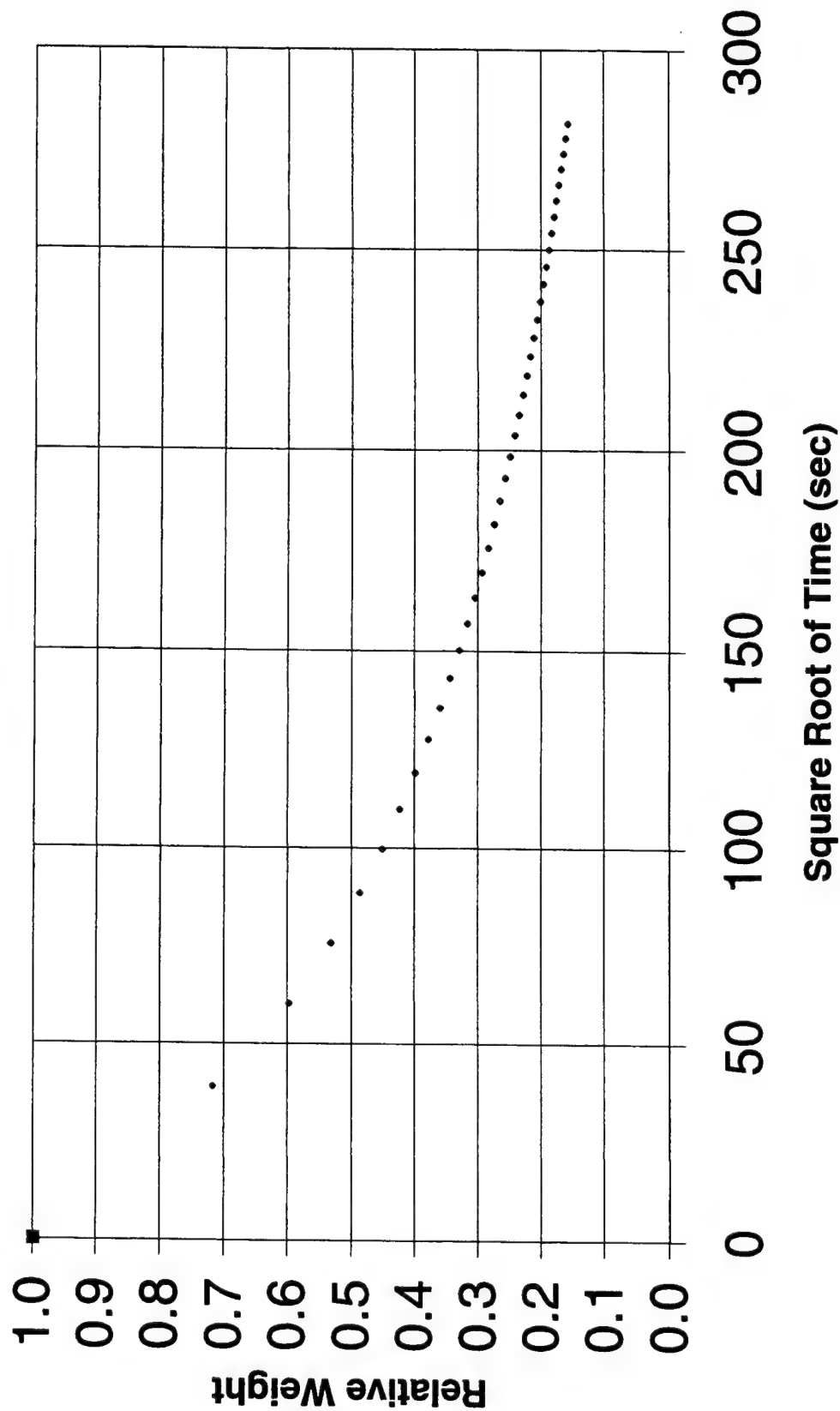


Figure . Fick's Law Plot of Desorption Diffusion (30 degrees C) of Supercritical Carbon Dioxide from Polymeric Materials: PMMA (075z)



TGA Time, min	Temp., deg C	TGA Wt., mg	TGA Time, sec	Adjusted Time, sec	Adjusted Time, hr	Adjusted SORT Adj. Time, sec	Wt. Loss, %	Fractional Wt. Loss	Wt. @ Zero Time, mg	Wt. @ Zero Time, %	TGA Dry Wt., mg #	Adjustment to TGA Time, sec	Hardness Scale
A	B	C	D	E	F	G	H	I	J	K	L	M	N
17.441	29.995	94.703	1046.460	1526.460	0.424	39.07	4.184	0.718	96.20	5.831	90.9	480	Shore D
52.464	30.001	94.065	3147.840	3627.840	1.008	60.23	3.482	0.597					
87.515	30.000	93.718	5250.900	5730.900	1.592	75.70	3.100	0.532					
122.531	30.000	93.478	7351.860	7831.860	2.176	88.50	2.836	0.486					
157.545	30.000	93.293	9452.700	9932.700	2.759	99.66	2.632	0.451					
192.572	30.000	93.142	11554.320	12034.320	3.343	109.70	2.466	0.423					
227.614	30.000	93.013	13656.840	14136.840	3.927	118.90	2.325	0.399					
262.634	30.000	92.902	15758.040	16238.040	4.511	127.43	2.203	0.378					
297.694	30.001	92.806	17861.640	18341.640	5.095	135.43	2.097	0.360					
332.732	30.000	92.720	19963.920	20443.920	5.679	142.98	2.002	0.343					
367.752	30.001	92.643	22065.120	22545.120	6.263	150.15	1.918	0.329					
402.766	30.000	92.575	24165.960	24645.960	6.846	156.99	1.842	0.316					
437.811	30.000	92.513	26268.660	26748.660	7.430	163.55	1.774	0.304					
472.841	30.000	92.455	28370.460	28850.460	8.014	169.85	1.711	0.293					
507.894	30.000	92.402	30473.640	30953.640	8.598	175.94	1.652	0.283					
542.918	30.000	92.352	32575.080	33055.080	9.182	181.81	1.598	0.274					
577.945	30.000	92.306	34676.700	35156.700	9.766	187.50	1.546	0.265					
612.993	30.000	92.261	36779.580	37259.580	10.350	193.03	1.498	0.257					
648.015	30.000	92.221	38880.900	39360.900	10.934	198.40	1.453	0.249					
683.029	30.000	92.182	40981.740	41461.740	11.517	203.62	1.410	0.242					
718.051	30.000	92.146	43083.060	43563.060	12.101	208.72	1.370	0.235					
753.066	30.000	92.111	45183.960	45663.960	12.684	213.69	1.333	0.229					
788.113	30.000	92.079	47286.780	47766.780	13.269	218.56	1.297	0.223					
823.150	30.000	92.049	49389.000	49869.000	13.853	223.31	1.264	0.217					
858.221	30.000	92.019	51493.260	51973.260	14.437	227.98	1.231	0.211					
893.287	30.000	91.992	53597.220	54077.220	15.021	232.55	1.201	0.206					
928.350	30.000	91.965	55701.000	56181.000	15.606	237.03	1.172	0.201					
963.405	30.000	91.939	57804.300	58284.300	16.190	241.42	1.143	0.196					
998.425	30.000	91.915	59905.500	60385.500	16.774	245.73	1.116	0.191					
1033.452	30.000	91.891	62007.120	62487.120	17.358	249.97	1.090	0.187					
1068.495	30.000	91.869	64109.700	64589.700	17.942	254.15	1.066	0.183					
1103.521	30.000	91.848	66211.260	66691.260	18.525	258.25	1.043	0.179					
1138.539	30.000	91.827	68312.340	68792.340	19.109	262.28	1.019	0.175					
1173.591	30.000	91.806	70415.460	70895.460	19.693	266.26	0.996	0.171					
1208.602	30.000	91.786	72516.120	72996.120	20.277	270.18	0.975	0.167					
1243.609	30.000	91.767	74616.540	75096.540	20.860	274.04	0.953	0.163					
1278.644	30.000	91.748	76718.640	77198.640	21.444	277.85	0.933	0.160					
1313.721	30.000	91.730	78823.260	79303.260	22.029	281.61	0.913	0.157					

Pre Exposure
Hardness
80.2

Post Desorption
Hardness
79.5

Change in
Hardness, %
-0.87

Formulae Used for Analysis of Data

Uppercase letters refer to columns

Lowercase n refers to row, beginning with n=4

$Dn = (An * 60)$

$En = (Dn + M4)$

$Fn = (En / 3600)$

$Gn = SQRT(En)$

$Hn = (((Cn - L4) / L4) * 100)$

$In = (((Cn - L4) / (J4 - L4))$

$K4 = (((J4 - L4) / L4) * 100)$

$N16 = (((N12 - N8) / N8) * 100)$

Source binary TA data file : pmma075z

14 lines in the parameter block

3 channels of data

Run 20

Module TGA 1000 oC

Sample PMMA sorbed in SCO2

Size 95.283 mg

Method DESORPTION-Isothermal

Operator BSI

Comment Dry weight: 90.9 mg

Nsig 3

Sig1 Time (min)

Sig2 Temperature (oC)

Sig3 Weight (mg)

Kcell 1.0000

Date 15-Mar-00

Time 11:35

Other balance used to obtain dry sample wt.

Blank

FIGURE . CHEMICAL-MATERIAL INTERACTION DATA SET:
Supercritical Carbon Dioxide and Polyphenylene Oxide PPO
Sorption, Desorption Diffusion, and Indentation Data Sets

Material Data

Test Reference Number:	<u>02-1-1</u>	TGA Filename:	<u>ppo0091d</u>
Property Test Specification:	ASTM D471/D543		
Material Name:	<u>Polyphenylene Oxide</u>	Material Code:	<u>PPO</u>
Material Supplier:	<u>Harbor City Plastics</u>	Material Class:	<u>TP</u>
Monomer Source:	<u>General Electric</u>	Base Polymer (Lot. No.):	<u>Noryl (NC8781)</u>
Exposure Liquid:	<u>Supercritical Carbon Dioxide</u>	Replicate Number:	<u>1</u>

Pre-Exposure Data

Measured Diameter (mm):	<u>10.14</u>	<u>10.03</u>	<u>10.01</u>	<u>10.08</u>	
Mean Diameter:	<u>10.065</u>				95% Confidence Level (CL): <u>0.092</u>
Measured Thickness (mils):	<u>35.10</u>	<u>36.10</u>	<u>34.30</u>	<u>34.90</u>	
Mean Thickness:	<u>35.100</u>				95% Confidence Level (CL): <u>1.191</u>
Initial Sample Weight (mg):	<u>74.200</u>				
Initial Durometer Hardness:	<u>76.2</u>	Scale: SHORE	<u>D</u>		

Sample Exposure Data

Exposure Date:	<u>03/31/00</u>	Time:	<u>14:12:00</u>
Removal Date:	<u>03/31/00</u>	Time:	<u>14:27:00</u>
Total Exposure Time (h:m:s):	<u>00:15:00</u>	Weight of Sample After Exposure (mg):	<u>76.90</u>
Weight Gain (mg):	<u>2.70</u>	Percent Weight Gain:	<u>3.64</u>
Final Durometer Hardness After Desorption:	<u>76.6</u>	Percent Hardness Change:	<u>0.5</u>

Desorption Experiment

Mean Temperature of Desorption Experiment (setpoint = 30 deg C):	<u>30.000</u>	95% CL:	<u>0.0006</u>
Time Lapse Between Sample Exposure and Sample Desorption (sec):			<u>495</u>
Equilibrium Weight of Desorbed Sample at 30 deg C (mg):			<u>74.380</u>
Sample Extracted (mg):	<u>-0.18</u>	Solubility Corrected for Extractables (mg):	<u>2.70</u>
Sample Extracted (%):	<u>-0.24</u>	Solubility Corrected for Extractables (%):	<u>3.64</u>

Diffusion Coefficient Data: Fick's Law

High Concentration Diffusion Coefficient (cm ² /sec):	<u>2.7634E-07</u>
Range Including Intercept (0,1), Relative Weight Fraction:	<u>1.00 - 0.55</u>
Linear Range of Desorption, Relative Weight Fraction:	<u>0.70 - 0.55</u>
Slope:	<u>-1.3307E-02</u>
X-axis Intercept:	<u>7.4801E+01</u>
R Square:	<u>0.99852</u>
Y-axis Intercept:	<u>9.9534E-01</u>
Low Concentration Diffusion Coefficient (cm ² /sec):	<u>1.6204E-10</u>
Linear Range of Desorption, Relative Weight Fraction:	<u>0.10 - 0.07</u>
Slope:	<u>-3.2222E-04</u>
X-axis Intercept:	<u>4.6923E+02</u>
R Square:	<u>0.94367</u>
Y-axis Intercept:	<u>1.5119E-01</u>

Wt. @ Zero Time, mg K 76.90	Wt. @ Zero Time, % L 3.639	Adjustment to TGA Time, sec M 495	Hardness Shore Scale N D
TGA Dry Wt., mg 74.200	Equil. Wt. Of Desorb. Sample 74.38	Min. Wt. Used For FDC, mg. 74.200	Pre Exposure Hardness 76.2
High Conc. DC, cm2/sec 2.7634E-07	Low Conc. DC, cm2/sec 1.6204E-10	Total Liquid Sorbed, mg. 2.700	Post Desorption Hardness 76.6
R Square 0.99852	R Square 0.94367		Change in Hardness, % 0.5
X Intercept 74.80	X Intercept 469.2		Mean Thickness, cm. 0.0892
Y Intercept 0.99534	Y Intercept 0.15119		
Y Intercept as Wt., mg. 76.542	X Intercept as Time, hrs. 61.2	X Intercept as Time, min. 367.0	ppo0091d X Intercept as Time, days 2.5

TEMPERATURE STATISTICS

<i>Column1</i>		Max. TGA Wt., (orig data file) 76.104	TGA Wt. At 20 min. Adjustment 75.665
Mean	30.0000646	Sorption @ 7-12 min., mg	Sorption @ 20 min., mg
Standard Error	0.000327842	1.90	1.47
Median	30		
Mode	30	Sorption @ 7-12 min., %	Sorption @ 20 min., %
Standard Deviation	0.01815015	2.57	1.97
Sample Variance	0.000329428		
Kurtosis	568.6634763	Rel. Error (%) of 7-12 min. Sorp.	Rel. Error (%) of 20 min. Sorp
Skewness	-15.90073963	-29.5	-45.7
Range	0.83		
Minimum	29.389		
Maximum	30.219		
Sum	91950.198		
Count	3065		
Confidence Level(95.0%)	0.000642813		

HIGH CONCENTRATION DIFFUSION COEFFICIENT

ppo0091d

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.99925928
R Square	0.998519109
Adjusted R Square	0.998451796
Standard Error	0.003572855
Observations	24

ANOVA

	df	SS	MS	F	Significance F
Regression	1	0.189359346	0.189359346	14833.9224	1.26428E-32
Residual	22	0.000280836	1.27653E-05		
Total	23	0.189640182			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	0.995342921	0.003090509	322.0643683	6.5574E-42	0.98893359	1.001752251
X Variable 1	-0.013306511	0.000109254	-121.7945911	1.2643E-32	-0.01353309	-0.013079933

LOW CONCENTRATION DIFFUSION COEFFICIENT

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.971426552
R Square	0.943669547
Adjusted R Square	0.943624518
Standard Error	0.001953709
Observations	1253

ANOVA

	df	SS	MS	F	Significance F
Regression	1	0.079993303	0.079993303	20957.2359	0
Residual	1251	0.004775039	3.81698E-06		
Total	1252	0.084768343			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	0.151194785	0.000493793	306.1905226	0	0.150226031	0.152163539
X Variable 1	-0.00032222	2.2258E-06	-144.7661422	0	-0.000326587	-0.000317854

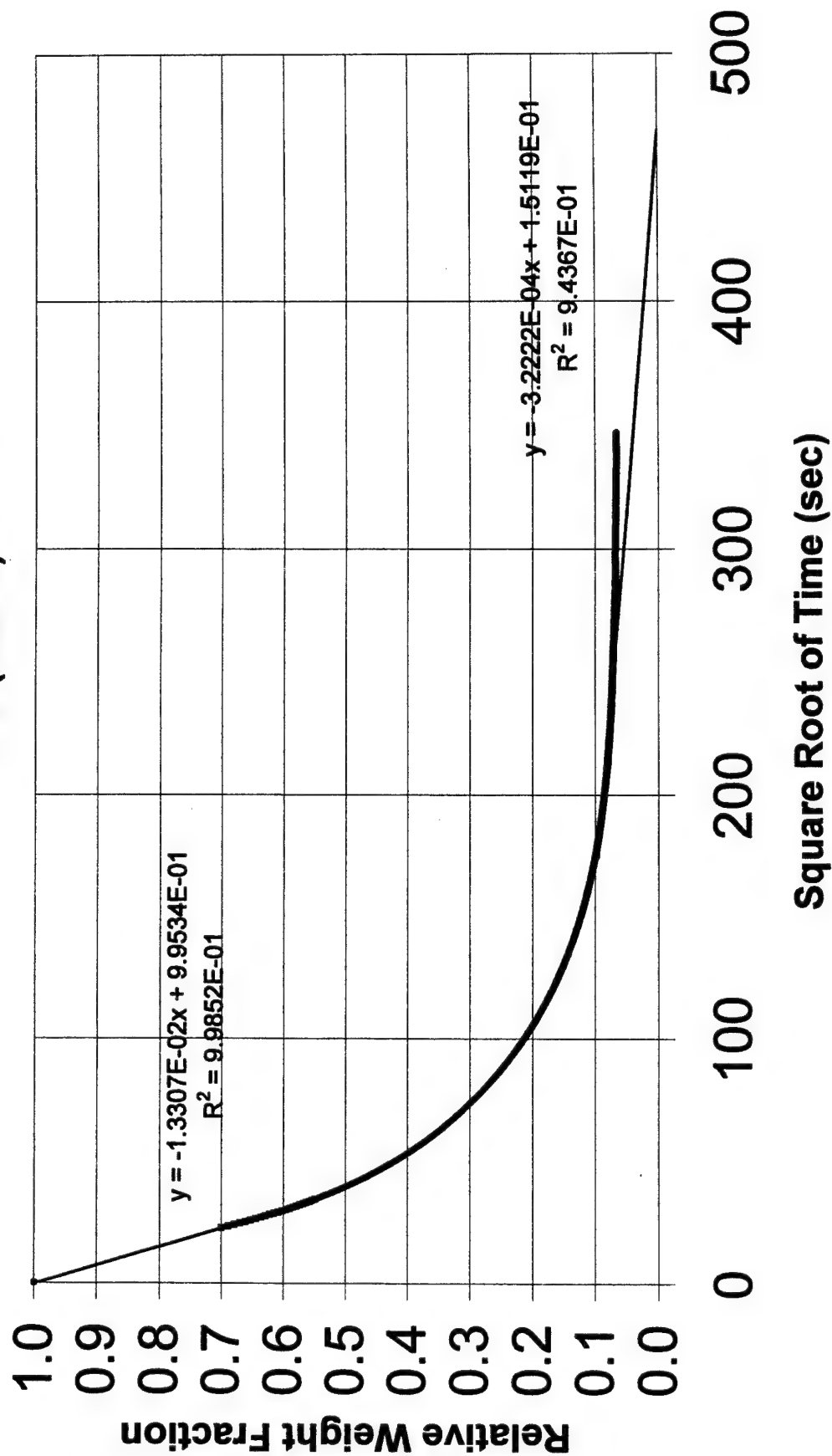
DIAMETER STATISTICS

<i>Column1</i>	
Mean	10.065
Standard Error	0.02901149
Median	10.055
Mode	#N/A
Standard Deviation	0.05802298
Sample Variance	0.00336667
Kurtosis	-1.0475444
Skewness	0.73716094
Range	0.13
Minimum	10.01
Maximum	10.14
Sum	40.26
Count	4
Confidence Level(95.0%)	0.0923276

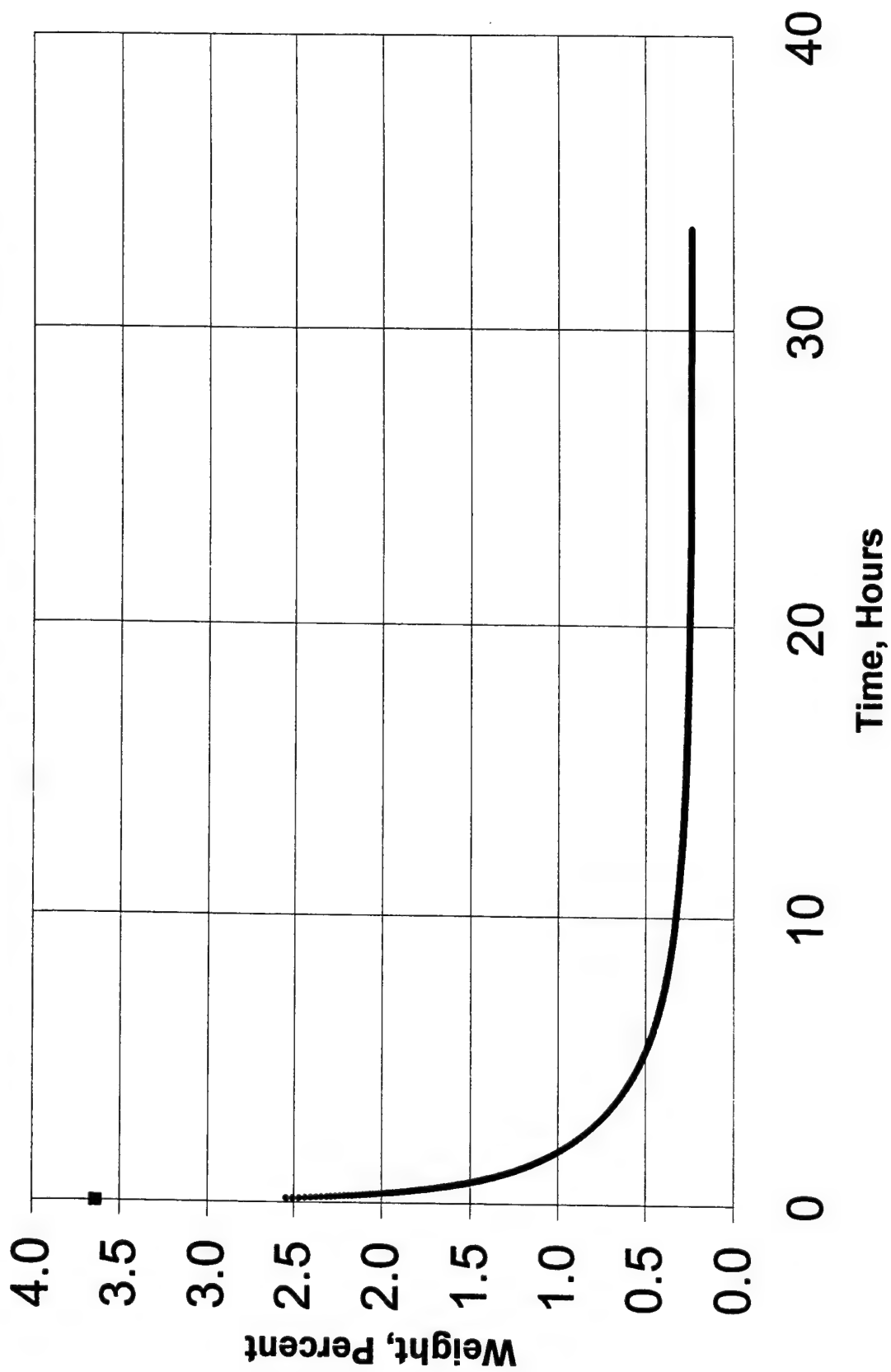
THICKNESS STATISTICS

<i>Column1</i>	
Mean	35.1
Standard Error	0.37416574
Median	35
Mode	#N/A
Standard Deviation	0.74833148
Sample Variance	0.56
Kurtosis	1.5
Skewness	0.76360355
Range	1.8
Minimum	34.3
Maximum	36.1
Sum	140.4
Count	4
Confidence Level(95.0%)	1.19076349

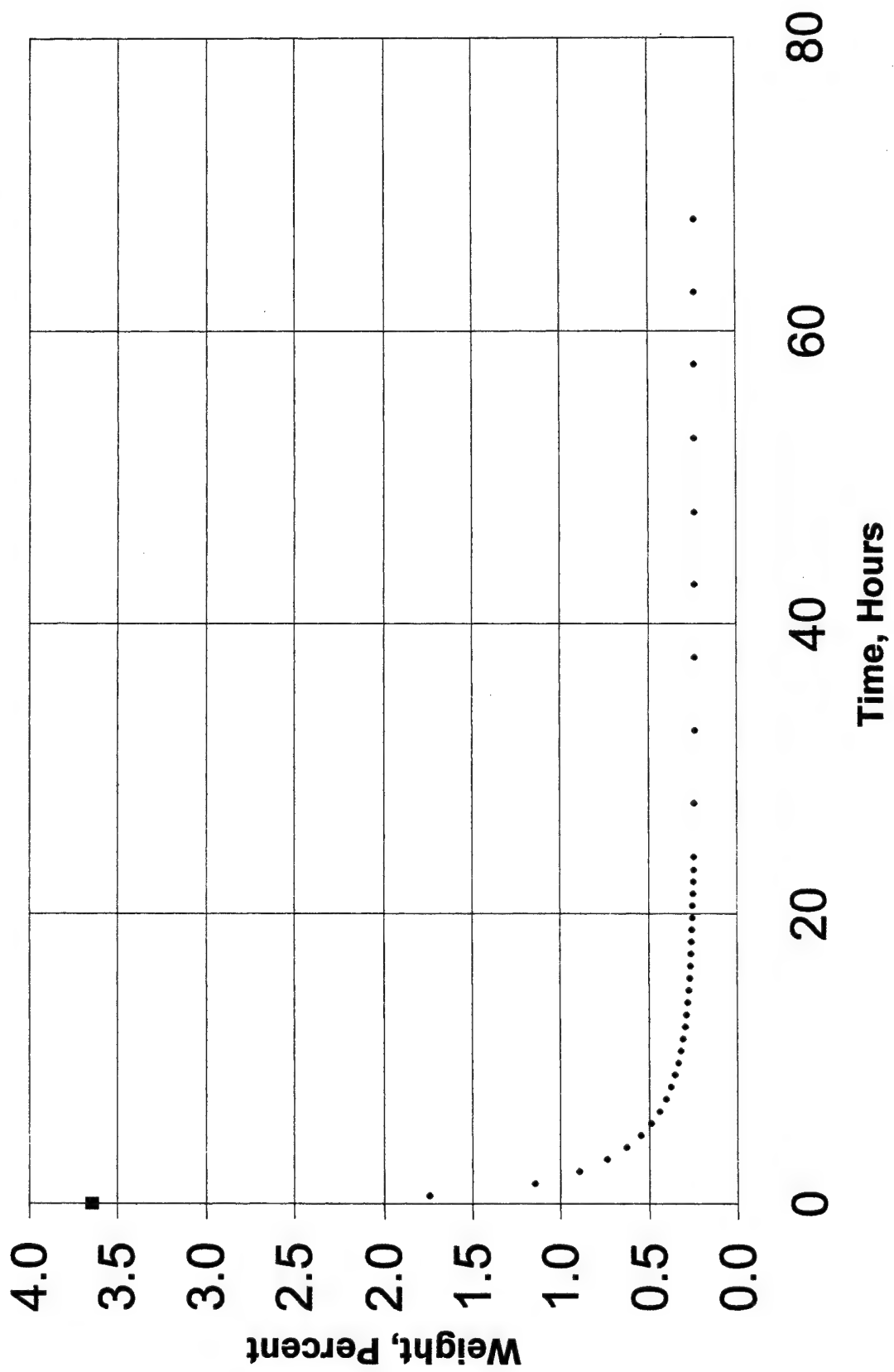
**Figure . Fick's Law Plot of Desorption Diffusion (30 degrees C)
of Supercritical Carbon Dioxide from Polymeric Materials:
PPO (0091d)**



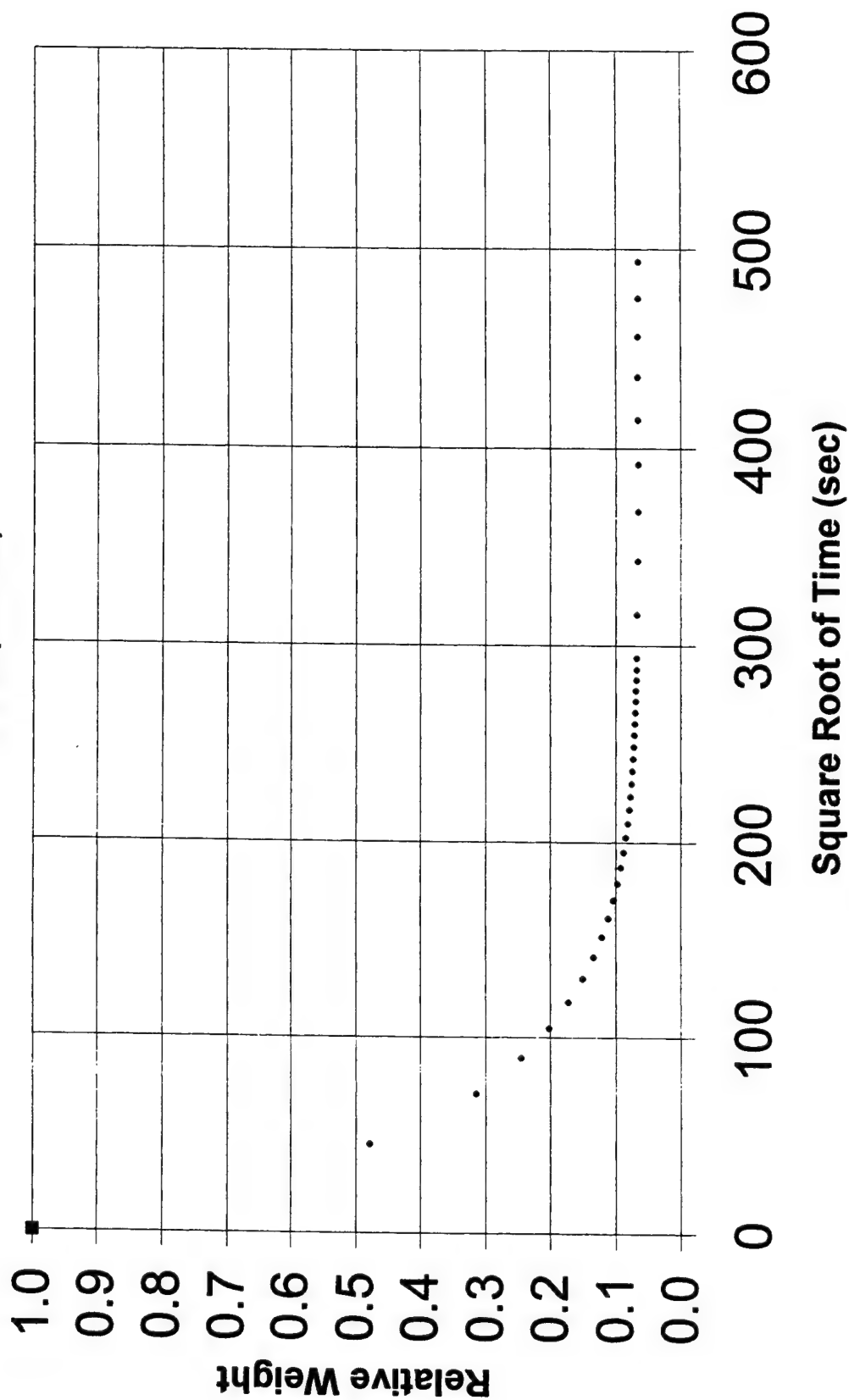
**Figure . Desorption Diffusion (30 degrees C) of Supercritical
Carbon Dioxide from Polymeric Materials: PPO (0091d)**



**Figure . Desorption Diffusion (30 degrees C) of Supercritical
Carbon Dioxide from Polymeric Materials: PPO (0091d)**



**Figure . Fick's Law Plot of Desorption Diffusion (30 degrees C) of Supercritical Carbon Dioxide from Polymeric Materials:
PPO (0091d)**



TGA Time, min	Temp., deg C	TGA Wt., mg	TGA Time, sec	Adjusted Time, sec	Adjusted Time, hr	SQRT Adj. Time, sec	Wt. Loss, %	Fractional Wt. Loss	Wt. @ Zero Time, mg	Wt. @ Zero Time, %	TGA Dry Wt., mg #	Adjustment to TGA Time, sec	Hardness Scale
A	B	C	D	E	F	G	H	I	J	K	L	M	N
24.916	29.998	75.492	1494.960	1989.960	0.553	44.61	1.741	0.479	76.90	3.639	74.2	495	Shore D
74.926	30.000	75.050	4495.560	4990.560	1.386	70.64	1.145	0.315					
125.014	30.000	74.862	7500.840	7995.840	2.221	89.42	0.892	0.245					
175.068	30.000	74.746	10504.080	10999.080	3.055	104.88	0.736	0.202					
225.133	30.000	74.666	13507.980	14002.980	3.890	118.33	0.627	0.172					
275.195	30.000	74.607	16511.700	17006.700	4.724	130.41	0.548	0.151					
325.262	30.000	74.582	19515.720	20010.720	5.559	141.46	0.488	0.134					
375.274	30.000	74.528	22516.440	23011.440	6.392	151.70	0.442	0.121					
425.303	30.000	74.501	25518.180	26013.180	7.226	161.29	0.406	0.112					
475.370	30.000	74.480	28522.200	29017.200	8.060	170.34	0.377	0.104					
525.462	30.000	74.463	31527.720	32022.720	8.895	178.95	0.354	0.097					
575.508	30.000	74.449	34530.480	35025.480	9.729	187.15	0.335	0.092					
625.592	30.001	74.438	37535.520	38030.520	10.564	195.01	0.320	0.088					
675.639	30.000	74.428	40538.340	41033.340	11.398	202.57	0.308	0.085					
725.724	30.000	74.420	43543.440	44038.440	12.233	209.85	0.296	0.081					
775.767	30.000	74.414	46546.020	47041.020	13.067	216.89	0.288	0.079					
825.823	30.000	74.408	49549.380	50044.380	13.901	223.71	0.281	0.077					
875.876	30.000	74.404	52552.560	53047.560	14.735	230.32	0.275	0.075					
925.921	30.000	74.400	55555.260	56050.260	15.570	236.75	0.270	0.074					
975.959	30.000	74.397	58557.540	59052.540	16.403	243.01	0.266	0.073					
1025.996	30.000	74.395	61559.760	62054.760	17.237	249.11	0.263	0.072					
1076.065	30.000	74.392	64563.900	65058.900	18.072	255.07	0.259	0.071					
1126.120	30.000	74.391	67567.200	68062.200	18.906	260.89	0.257	0.071					
1176.203	30.000	74.389	70572.180	71067.180	19.741	266.58	0.254	0.070					
1226.287	30.000	74.387	73577.220	74072.220	20.576	272.16	0.252	0.069					
1276.365	30.000	74.386	76581.900	77076.900	21.410	277.63	0.250	0.069					
1326.441	30.000	74.384	79586.460	80081.460	22.245	282.99	0.248	0.068					
1376.496	30.000	74.383	82589.760	83084.760	23.079	288.24	0.246	0.068					
1432.230	30.000	74.382	85593.800	86088.800	23.914	293.99	0.245	0.067					
1654.891	30.000	74.381	89293.460	89788.460	24.749	300.00	0.244	0.067					
1954.896	30.000	74.378	117293.760	117788.760	32.719	315.89	0.243	0.066					
2254.896	30.000	74.377	135293.760	135788.760	37.719	343.20	0.239	0.066					
2554.916	30.000	74.377	153294.960	153789.960	42.719	368.50	0.239	0.066					
2854.918	30.000	74.377	171295.080	171790.080	47.719	392.16	0.238	0.066					
3154.921	30.000	74.378	189295.260	189790.260	52.720	435.65	0.239	0.066					
3454.927	30.000	74.377	207295.620	207790.620	57.720	455.84	0.238	0.065					
3754.941	30.000	74.376	225296.460	225791.460	62.720	475.18	0.237	0.065					
4054.946	30.000	74.374	243296.760	243791.760	67.720	493.75	0.235	0.065					

Other balance used to obtain dry sample wt.

Pre Exposure
Hardness

76.2

Post Desorption
Hardness

76.6

Change in
Hardness, %

0.52

Formulae Used for Analysis of Data

Uppercase letters refer to columns

Lowercase n refers to row, beginning with n=4

 $Dn = (An * 60)$ $En = (Dn + M4)$ $Fn = (En / 3600)$ $Gn = SQRT(En)$ $Hn = (((Cn - L4) / L4) * 100)$ $In = (((Cn - L4) / (J4 - L4))$ $K4 = (((J4 - L4) / L4) * 100)$ $N16 = (((N12 - N8) / N8) * 100)$

Source binary TA data file : ppo0091d.01

14 lines in the parameter block

3 channels of data

Run 25

Module TGA Aluminum Pans

Sample PPO SCCO2 0091D

Size 76.104 mg

Method DESORPTION-Isothermal

Operator WJS

Comment Disk: 4x0.03 in. HP@1400x50 Dry Wt. DS: 74.2 ET: 8:00

Nsig 3

Sig1 Time (min)

Sig2 Temperature (°C)

Sig3 Weight (mg)

Kcell 1.0000

Date 31-Mar-00

Time 14:36

Blank

FIGURE . CHEMICAL-MATERIAL INTERACTION DATA SET:
Supercritical Carbon Dioxide and Polyphenylene Oxide PPO
Sorption, Desorption Diffusion, and Indentation Data Sets

Material Data

Test Reference Number:	<u>02-1-2</u>	TGA Filename:	<u>ppo0096d</u>
Property Test Specification:	ASTM D471/D543		
Material Name:	<u>Polyphenylene Oxide</u>	Material Code:	<u>PPO</u>
Material Supplier:	<u>Harbor City Plastics</u>	Material Class:	<u>TP</u>
Monomer Source:	<u>General Electric</u>	Base Polymer (Lot. No.):	<u>Noryl (NC8781)</u>
Exposure Liquid:	<u>Supercritical Carbon Dioxide</u>	Replicate Number:	<u>2</u>

Pre-Exposure Data

Measured Diameter (mm):	<u>10.16</u>	<u>10.1</u>	<u>10.06</u>	<u>10.18</u>	
Mean Diameter:	<u>10.125</u>				95% Confidence Level (CL): <u>0.088</u>
Measured Thickness (mils):	<u>33.40</u>	<u>34.00</u>	<u>33.70</u>	<u>33.20</u>	
Mean Thickness:	<u>33.575</u>				95% Confidence Level (CL): <u>0.557</u>
Initial Sample Weight (mg):	<u>69.900</u>				
Initial Durometer Hardness:	<u>75.6</u>	Scale: SHORE	<u>D</u>		

Sample Exposure Data

Exposure Date:	<u>04/06/00</u>	Time:	<u>10:49:00</u>
Removal Date:	<u>04/06/00</u>	Time:	<u>11:04:00</u>
Total Exposure Time (h:m:s):	<u>00:15:00</u>	Weight of Sample After Exposure (mg):	<u>72.90</u>
Weight Gain (mg):	<u>3.00</u>	Percent Weight Gain:	<u>4.29</u>
Final Durometer Hardness After Desorption:	<u>75.8</u>	Percent Hardness Change:	<u>0.3</u>

Desorption Experiment

Mean Temperature of Desorption Experiment (setpoint = 30 deg C):	<u>30.000</u>	95% CL:	<u>0.0007</u>
Time Lapse Between Sample Exposure and Sample Desorption (sec):			<u>465</u>
Equilibrium Weight of Desorbed Sample at 30 deg C (mg):			<u>70.020</u>
Sample Extracted (mg):	<u>-0.12</u>	Solubility Corrected for Extractables (mg):	<u>3.00</u>
Sample Extracted (%):	<u>-0.17</u>	Solubility Corrected for Extractables (%):	<u>4.29</u>

Diffusion Coefficient Data: Fick's Law

High Concentration Diffusion Coefficient (cm ² /sec):	<u>3.2831E-07</u>
Range Including Intercept (0,1), Relative Weight Fraction:	<u>1.00 - 0.50</u>
Linear Range of Desorption, Relative Weight Fraction:	<u>0.63 - 0.50</u>
Slope:	<u>-1.5163E-02</u>
X-axis Intercept:	<u>6.4395E+01</u>
R Square:	<u>0.98852</u>
Y-axis Intercept:	<u>9.7639E-01</u>
Low Concentration Diffusion Coefficient (cm ² /sec):	<u>5.0719E-11</u>
Linear Range of Desorption, Relative Weight Fraction:	<u>0.07 - 0.04</u>
Slope:	<u>-1.8846E-04</u>
X-axis Intercept:	<u>4.9037E+02</u>
R Square:	<u>0.86699</u>
Y-axis Intercept:	<u>9.2416E-02</u>

Wt. @ Zero Time, mg K 72.90	Wt. @ Zero Time, % L 4.292	Adjustment to TGA Time, sec M 465	Hardness Shore Scale N D
TGA Dry Wt., mg 69.900	Equil. Wt. Of Desorb. Sample 70.02	Min. Wt. Used For FDC, mg. 69.900	Pre Exposure Hardness 75.6
High Conc. DC, cm2/sec 3.2831E-07	Low Conc. DC, cm2/sec 5.0719E-11	Total Liquid Sorbed, mg. 3.000	Post Desorption Hardness 75.8
R Square 0.98852	R Square 0.86699		Change in Hardness, % 0.3
X Intercept 64.39	X Intercept 490.4		Mean Thickness, cm. 0.0853
Y Intercept 0.97639	Y Intercept 0.09242		
Y Intercept as Wt., mg. 71.179	X Intercept as Time, hrs. 66.8	X Intercept as Time, min. 400.8	ppo0096d X Intercept as Time, days 2.8

TEMPERATURE STATISTICS

<i>Column1</i>		Max. TGA Wt., (orig data file) 71.818	TGA Wt. At 20 min. Adjustment 71.335
Mean	30.00018117	Sorption @ 7-12 min., mg	Sorption @ 20 min., mg
Standard Error	0.000342847	1.92	1.43
Median	30		
Mode	30.001	Sorption @ 7-12 min., %	Sorption @ 20 min., %
Standard Deviation	0.018665481	2.74	2.05
Sample Variance	0.0003484		
Kurtosis	477.8445073		
Skewness	-13.7793311	Rel. Error (%) of 7-12 min. Sorp.	Rel. Error (%) of 20 min. Sorp
Range	0.815	-36.1	-52.2
Minimum	29.414		
Maximum	30.229		
Sum	88920.537		
Count	2964		
Confidence Level(95.0%)	0.000672242		

HIGH CONCENTRATION DIFFUSION COEFFICIENT

ppo0096d

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.994245135
R Square	0.988523388
Adjusted R Square	0.987949557
Standard Error	0.011315319
Observations	22

ANOVA

	df	SS	MS	F	Significance F
Regression	1	0.220565126	0.220565126	1722.67459	7.02123E-21
Residual	20	0.002560729	0.000128036		
Total	21	0.223125855			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	0.97639493	0.009936018	98.2682294	2.5088E-28	0.95568769	0.997121092
X Variable 1	-0.015162683	0.000365321	-41.50511524	7.0212E-21	-0.015924729	-0.014400638

LOW CONCENTRATION DIFFUSION COEFFICIENT

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.93112234
R Square	0.866988812
Adjusted R Square	0.866922638
Standard Error	0.002762891
Observations	2012

ANOVA

	df	SS	MS	F	Significance F
Regression	1	0.100011233	0.100011233	13101.5108	0
Residual	2010	0.015343465	7.63356E-06		
Total	2011	0.115354699			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	0.092415842	0.000394355	234.3466947	0	0.091642455	0.093189229
X Variable 1	-0.000188461	1.64649E-06	-114.4618313	0	-0.00019169	-0.000185232

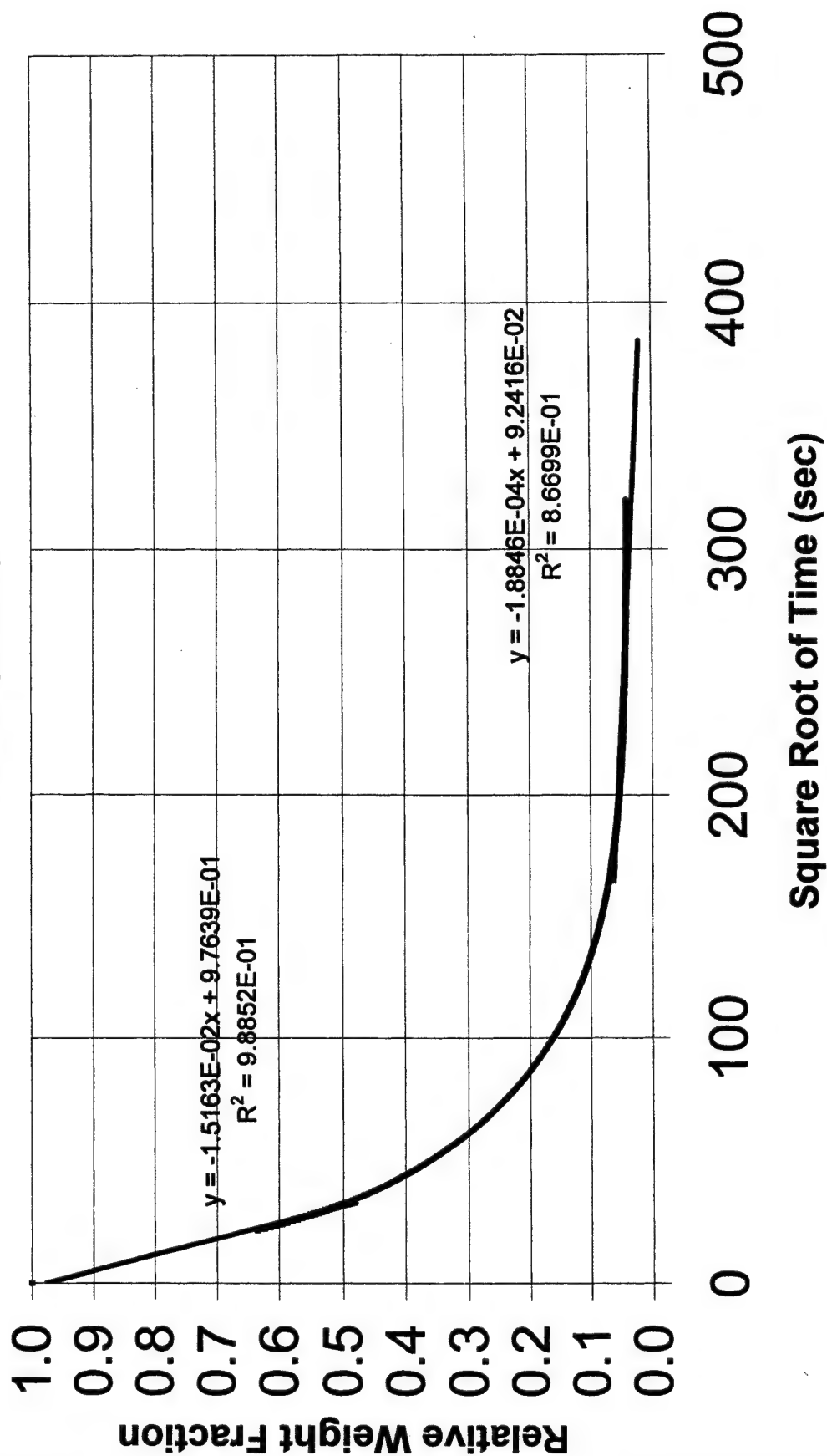
DIAMETER STATISTICS

<i>Column1</i>	
Mean	10.125
Standard Error	0.02753785
Median	10.13
Mode	#N/A
Standard Deviation	0.05507571
Sample Variance	0.00303333
Kurtosis	-3.032967
Skewness	-0.3232814
Range	0.12
Minimum	10.06
Maximum	10.18
ND/value	Sum 40.5
ND/value	Count 4
A/D	Confidence Level(95.0%) 0.08763782

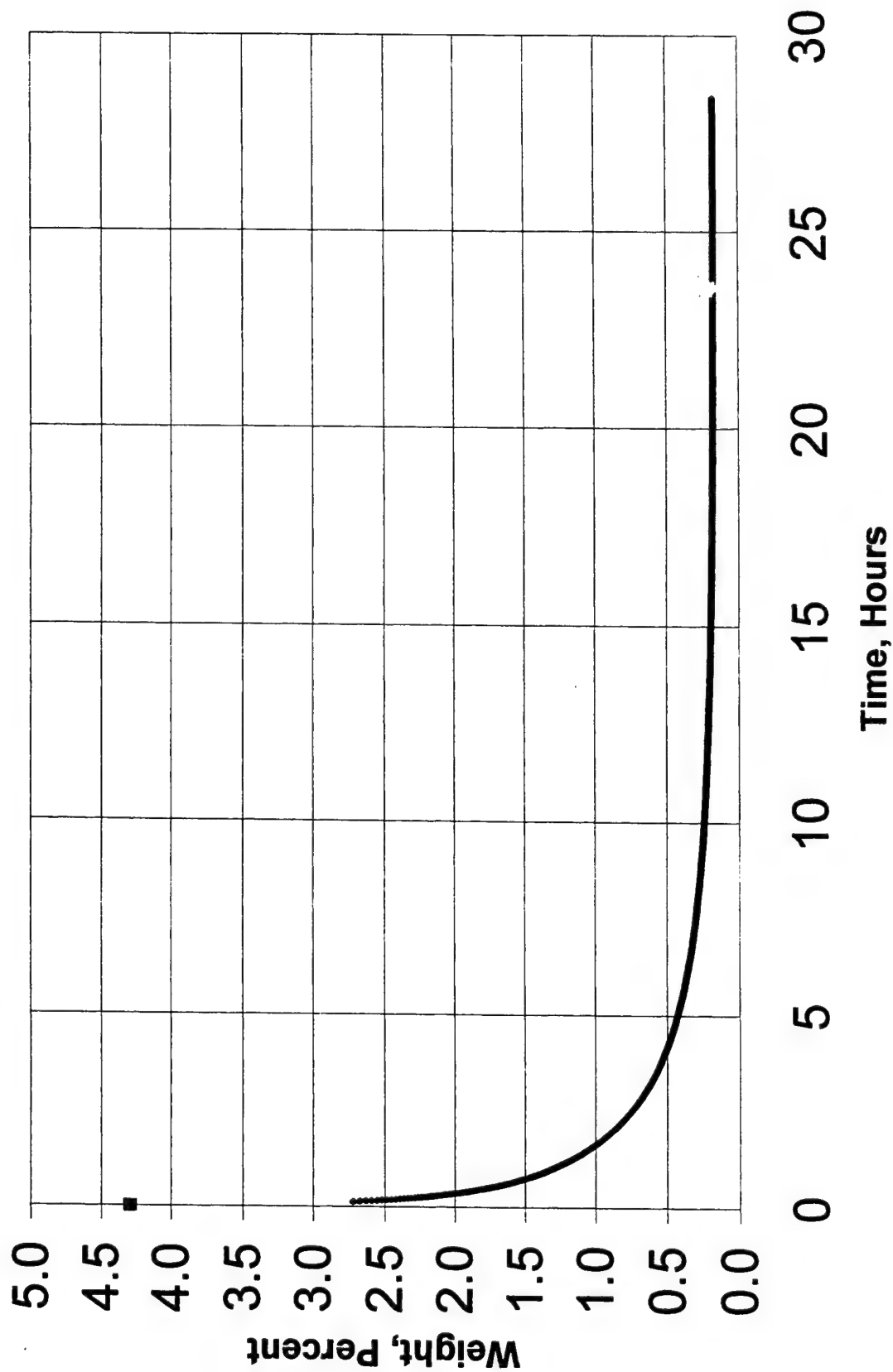
THICKNESS STATISTICS

<i>Column1</i>	
Mean	33.575
Standard Error	0.175
Median	33.55
Mode	#N/A
Standard Deviation	0.35
Sample Variance	0.1225
Kurtosis	-1.5976676
Skewness	0.32069971
Range	0.8
Minimum	33.2
Maximum	34
Sum	134.3
Count	4
Noryl (NC8781) ppo0096d	Confidence Level(95.0%) 0.55692863

**Figure . Fick's Law Plot of Desorption Diffusion (30 degrees C)
of Supercritical Carbon Dioxide from Polymeric Materials:
PPO (0096d)**



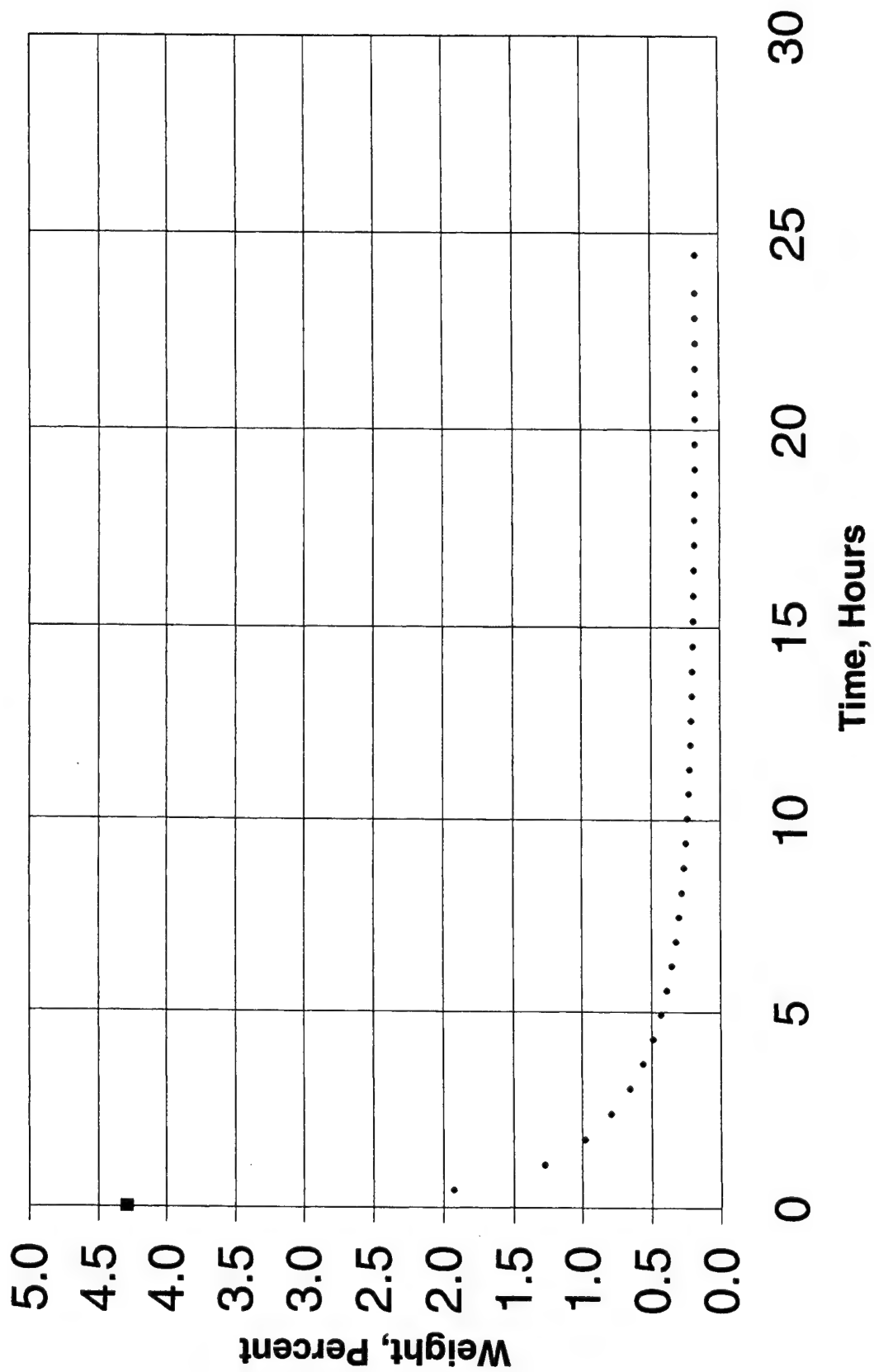
**Figure . Desorption Diffusion (30 degrees C) of Supercritical
Carbon Dioxide from Polymeric Materials: PPO (0096d)**



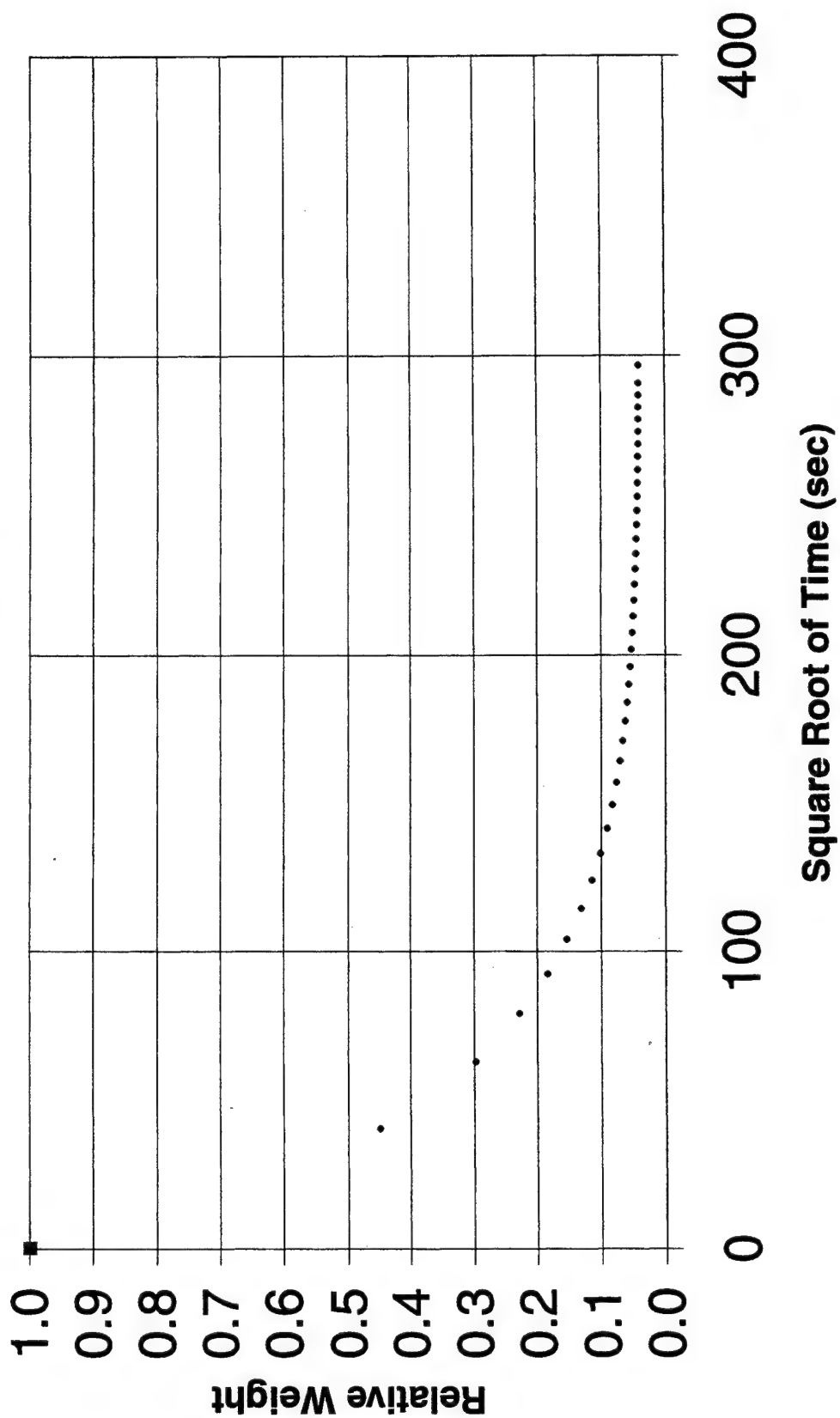
TGA Time, min	Temp., deg C	TGA Wt., mg	TGA Time, sec	Adjusted Time, sec	Adjusted Time, hr	SQRT Adj. Time, sec	Wt. Loss, %	Fractional Wt. Loss	Wt. @ Zero Time, mg	Wt. @ Zero Time, %	TGA Dry Wt., mg	Adjustment to TGA Time, sec	Hardness Scale
A	B	C	D	E	F	G	H	I	J	K	L	M	N
19.104	29.997	71.248	1146.240	1611.240	0.448	40.14	1.929	0.449	72.90	4.292	69.9	465	Shore D
57.454	30.000	70.793	3447.240	3912.240	1.087	62.55	1.277	0.298					
95.804	30.000	70.586	5748.240	6213.240	1.726	78.82	0.981	0.229					
134.163	30.000	70.454	8049.780	8514.780	2.365	92.28	0.792	0.185					
172.538	30.002	70.361	10352.280	10817.280	3.005	104.01	0.660	0.154					
210.936	30.002	70.294	12656.160	13121.160	3.645	114.55	0.563	0.131					
249.333	30.000	70.243	14959.980	15424.980	4.285	124.20	0.491	0.114					
287.703	30.000	70.205	17262.180	17727.180	4.924	133.14	0.436	0.101					
326.083	30.000	70.174	19564.980	20029.980	5.564	141.53	0.392	0.091					
364.453	30.000	70.149	21867.180	22332.180	6.203	149.44	0.357	0.083					
402.827	30.000	70.129	24169.620	24634.620	6.843	156.95	0.328	0.076					
441.198	30.000	70.113	26471.880	26936.880	7.482	164.12	0.305	0.071					
479.573	30.000	70.100	28774.380	29239.380	8.122	171.00	0.285	0.067					
517.956	30.000	70.088	31077.360	31542.360	8.762	177.60	0.269	0.063					
556.355	30.000	70.078	33381.300	33846.300	9.402	183.97	0.255	0.059					
594.733	30.000	70.070	35683.980	36148.980	10.041	190.13	0.243	0.057					
633.144	30.000	70.064	37988.640	38453.640	10.682	196.10	0.234	0.055					
671.575	30.000	70.058	40294.500	40759.500	11.322	201.89	0.226	0.053					
709.958	30.000	70.053	42597.480	43062.480	11.962	207.52	0.219	0.051					
748.328	30.000	70.049	44899.680	45364.680	12.601	212.99	0.212	0.049					
786.680	30.000	70.045	47200.800	47665.800	13.241	218.32	0.208	0.048					
825.082	30.000	70.041	49504.920	49969.920	13.881	223.54	0.202	0.047					
863.468	30.000	70.039	51808.080	52273.080	14.520	228.63	0.198	0.046					
901.822	30.000	70.037	54109.320	54574.320	15.160	233.61	0.195	0.046					
940.216	30.000	70.035	56412.960	56877.960	15.799	238.49	0.193	0.045					
978.594	30.000	70.033	58715.640	59180.640	16.439	243.27	0.190	0.044					
1016.990	30.000	70.031	61019.400	61484.400	17.079	247.96	0.188	0.044					
1055.381	30.000	70.030	63322.860	63787.860	17.719	252.56	0.186	0.043					
1093.802	30.000	70.029	65628.120	66093.120	18.359	257.09	0.184	0.043					
1132.167	30.000	70.027	67930.020	68395.020	18.999	261.52	0.182	0.042					
1170.526	30.000	70.027	70231.560	70696.560	19.638	265.89	0.181	0.042					
1208.882	30.000	70.026	72532.920	72997.920	20.277	270.18	0.180	0.042					
1247.292	30.000	70.025	74837.520	75302.520	20.917	274.41	0.179	0.042					
1285.691	30.000	70.025	77141.460	77606.460	21.557	278.58	0.178	0.042					
1324.052	30.000	70.024	79443.120	79908.120	22.197	282.68	0.177	0.041					
1362.420	30.000	70.024	81745.200	82210.200	22.836	286.72	0.177	0.041					
1400.795	30.000	70.023	84047.700	84512.700	23.476	290.71	0.176	0.041					
1459.128	30.000	70.022	87547.680	88012.680	24.448	296.67	0.175	0.041					

Other balance used to obtain dry sample wt.

**Figure . Desorption Diffusion (30 degrees C) of Supercritical
Carbon Dioxide from Polymeric Materials: PPO (0096d)**



**Figure . Fick's Law Plot of Desorption Diffusion (30 degrees C) of
Supercritical Carbon Dioxide from Polymeric Materials:
PPO (0096d)**



Blank

PVC

Material Data

Test Reference Number:	03-1-1	TGA Filename:	<u>pvc0089d</u>
Property Test Specification:	ASTM D471/D543		
Material Name:	<u>Polyvinyl Chloride</u>	Material Code:	<u>PVC</u>
Material Supplier:	<u>Harbor City Plastics</u>	Material Class:	<u>TP</u>
Monomer Source:	<u>Georgia Gulf</u>	Base Polymer (Lot. No.):	<u>(4576T1)</u>
Exposure Liquid:	Supercritical Carbon Dioxide	Replicate Number:	1

Measured Diameter (mm):	<u>11.42</u>	<u>11.48</u>	<u>11.45</u>	<u>11.31</u>	
Mean Diameter:	<u>11.415</u>				95% Confidence Level (CL): <u>0.118</u>
Measured Thickness (mils):	<u>39.80</u>	<u>38.50</u>	<u>41.00</u>	<u>39.00</u>	
Mean Thickness:	<u>39.575</u>				95% Confidence Level (CL): <u>1.735</u>
Initial Sample Weight (mg):	<u>105.249</u>				
Initial Durometer Hardness:	<u>73.4</u>	Scale: SHORE		D	

Exposure Date:	<u>03/29/00</u>	Time:	<u>13:30:00</u>
Removal Date:	<u>03/29/00</u>	Time:	<u>13:45:00</u>
Total Exposure Time (h:m:s):	<u>00:15:00</u>	Weight of Sample After Exposure (mg):	<u>106.80</u>
Weight Gain (mg):	<u>1.55</u>	Percent Weight Gain:	<u>1.47</u>
Final Durometer Hardness After Desorption:	<u>71.5</u>	Percent Hardness Change:	<u>-2.6</u>

Mean Temperature of Desorption Experiment (setpoint = 30 deg C):	<u>30.001</u>	95% CL:	<u>0.0016</u>
Time Lapse Between Sample Exposure and Sample Desorption (sec):		.	<u>660</u>
Equilibrium Weight of Desorbed Sample at 30 deg C (mg):			<u>105.280</u>
Sample Extracted (mg):	<u>-0.03</u>	Solubility Corrected for Extractables (mg):	<u>1.55</u>
Sample Extracted (%):	<u>-0.03</u>	Solubility Corrected for Extractables (%):	<u>1.47</u>

High Concentration Diffusion Coefficient (cm ² /sec):	<u>1.2426E-07</u>
Range Including Intercept (0,1), Relative Weight Fraction:	<u>1.00 - 0.65</u>
Linear Range of Desorption, Relative Weight Fraction:	<u>0.78 - 0.65</u>
Slope:	<u>-7.9140E-03</u>
X-axis Intercept:	<u>1.2501E+02</u>
R Square:	<u>0.99783</u>
Y-axis Intercept:	<u>9.8937E-01</u>

Low Concentration Diffusion Coefficient (cm ² /sec):	<u>1.5727E-09</u>
Linear Range of Desorption, Relative Weight Fraction:	<u>0.07 - 0.02</u>
Slope: <u>-8.9033E-04</u>	X-axis Intercept: <u>3.2360E+02</u>
R Square: <u>0.99847</u>	Y-axis Intercept: <u>2.8812E-01</u>

Wt. @ Zero Time, mg K 106.80	Wt. @ Zero Time, % L 1.474	Adjustment to TGA Time, sec M 660	Hardness Shore Scale N D
TGA Dry Wt., mg 105.249	Equil. Wt. Of Desorb. Sample 105.28	Min. Wt. Used For FDC, mg. 105.249	Pre Exposure Hardness 73.4
High Conc. DC, cm2/sec 1.2426E-07	Low Conc. DC, cm2/sec 1.5727E-09	Total Liquid Sorbed, mg. 1.551	Post Desorption Hardness 71.5
R Square 0.99783	R Square 0.99847		Change in Hardness, % -2.6
X Intercept 125.01	X Intercept 323.6		Mean Thickness, cm. 0.1005
Y Intercept 0.98937	Y Intercept 0.28812		
Y Intercept as Wt., mg. 105.665	X Intercept as Time, hrs. 29.1	X Intercept as Time, min. 174.5	pvc0089d X Intercept as Time, days 1.2

TEMPERATURE STATISTICS

Column1		Max. TGA Wt., (orig data file) 106.469	TGA Wt. At 20 min. Adjustment 106.354
Mean	30.00078699	Sorption @ 7-12 min., mg	Sorption @ 20 min., mg
Standard Error	0.000801693	1.22	1.11
Median	30		
Mode	30	Sorption @ 7-12	Sorption @ 20
Standard Deviation	0.043321102	min., %	min., %
Sample Variance	0.001876718	1.16	1.05
Kurtosis	256.1938329		
Skewness	-6.545547698	Rel. Error (%) of	Rel. Error (%) of
Range	1.567	7-12 min. Sorp.	20 min. Sorp
Minimum	28.934	-21.3	-28.8
Maximum	30.501		
Sum	87602.298		
Count	2920		
Confidence Level(95.0%)	0.00157194		

DIAMETER STATISTICS

<i>Column1</i>	
Mean	11.415
Standard Error	0.03708099
Median	11.435
Mode	#N/A
Standard Deviation	0.07416198
Sample Variance	0.0055
Kurtosis	2.02644628
Skewness	-1.3729161
Range	0.17
Minimum	11.31
Maximum	11.48
Sum	45.66
Count	4
Confidence Level(95.0%)	0.11800838

ND/value
ND/value
A/D

THICKNESS STATISTICS

<i>Column1</i>	
Mean	39.575
Standard Error	0.54524459
Median	39.4
Mode	#N/A
Standard Deviation	1.09048919
Sample Variance	1.18916667
Kurtosis	-0.3686457
Skewness	0.75707136
Range	2.5
Minimum	38.5
Maximum	41
Sum	158.3
Count	4
Confidence Level(95.0%)	1.73521327

(4576T1)
pvc0089d

HIGH CONCENTRATION DIFFUSION COEFFICIENT

pvc0089d

SUMMARY OUTPUT

<i>Regression Statistics</i>	
Multiple R	0.998914632
R Square	0.997830441
Adjusted R Square	0.997777525
Standard Error	0.002797958
Observations	43

ANOVA

	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	1	0.147622177	0.147622177	18856.8519	3.08293E-56
Residual	41	0.000320971	7.82857E-06		
Total	42	0.147943149			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>
Intercept	0.989368347	0.002041735	484.572376	1.1317E-78	0.985244978	0.993491717
X Variable 1	-0.007914049	5.76321E-05	-137.3202531	3.0829E-56	-0.008030439	-0.007797659

LOW CONCENTRATION DIFFUSION COEFFICIENT

SUMMARY OUTPUT

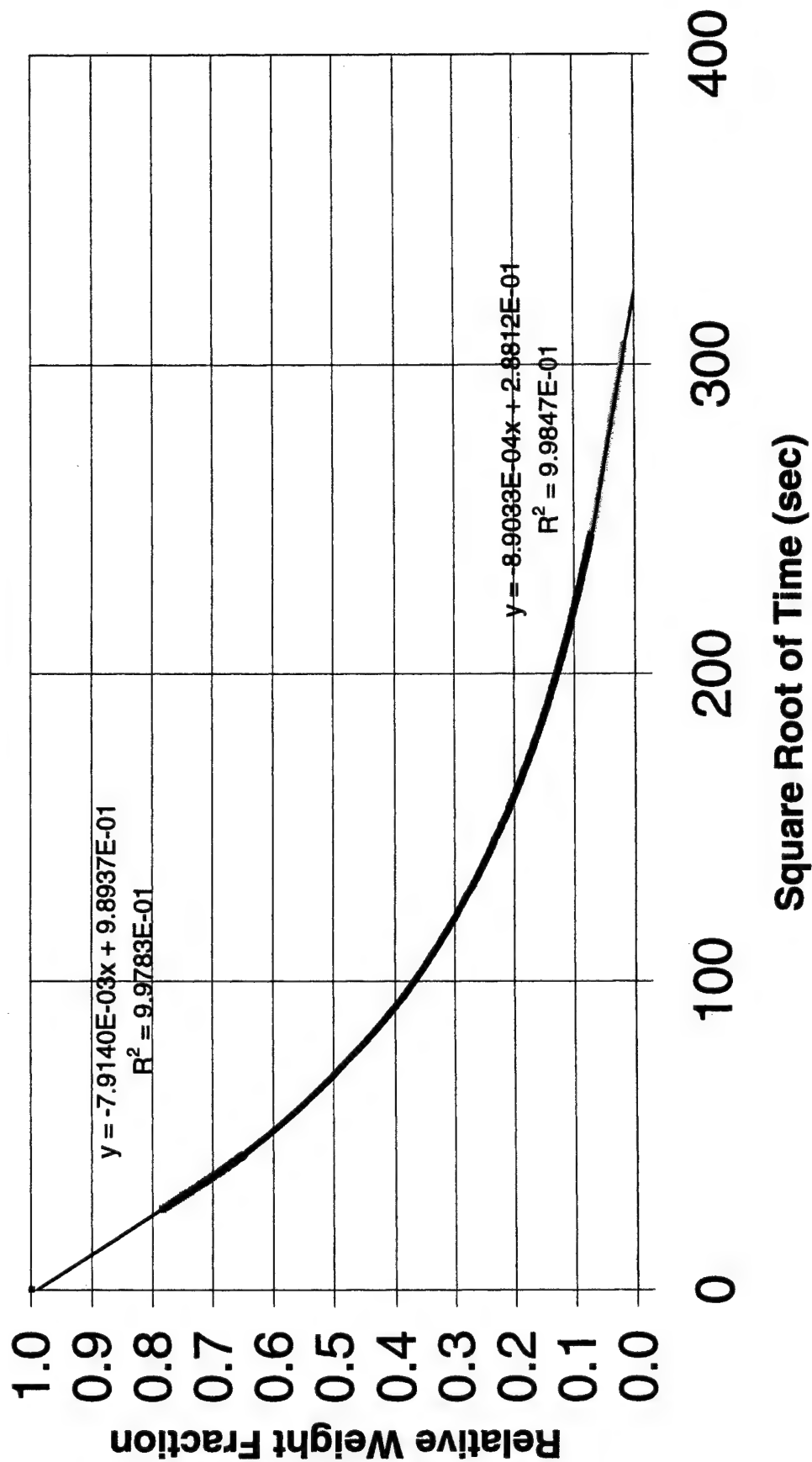
<i>Regression Statistics</i>	
Multiple R	0.999235225
R Square	0.998471034
Adjusted R Square	0.99846937
Standard Error	0.000523843
Observations	921

ANOVA

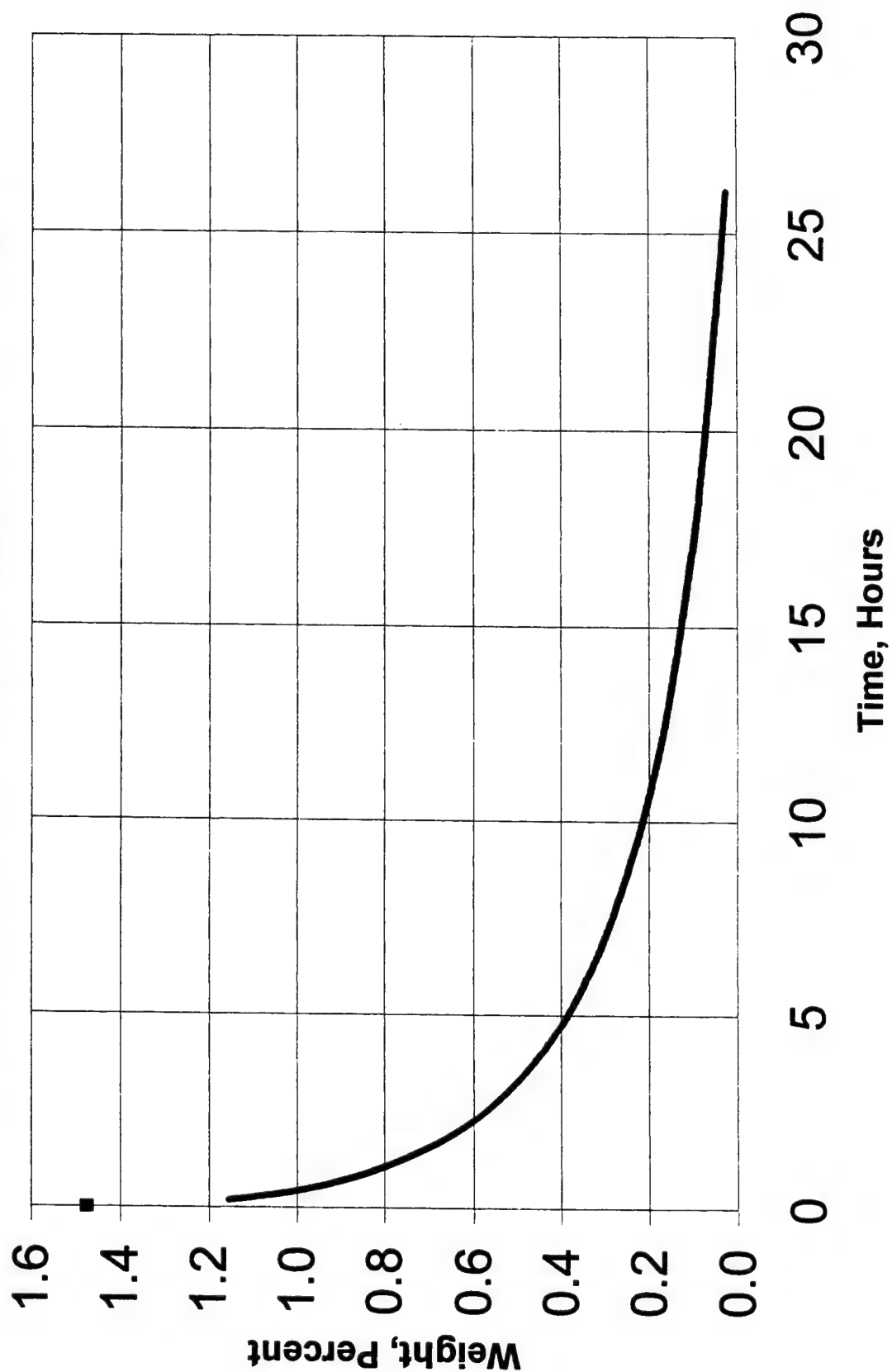
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	1	0.164685731	0.164685731	600140.821	0
Residual	919	0.000252184	2.74412E-07		
Total	920	0.164937915			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>
Intercept	0.288115378	0.000313944	917.729431	0	0.287499249	0.288731508
X Variable 1	-0.000890331	1.14928E-06	-774.6875633	0	-0.000892587	-0.000888076

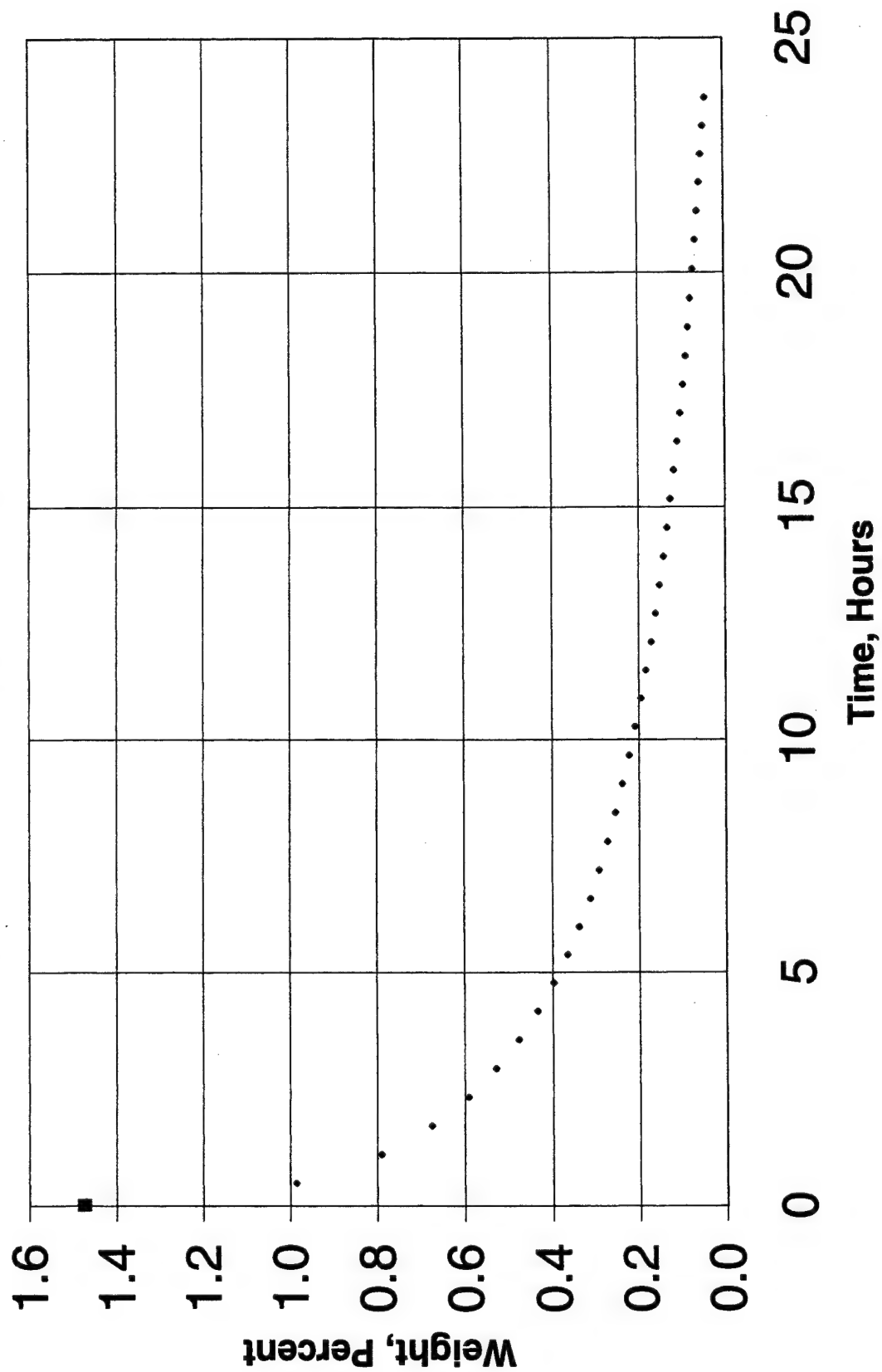
**Figure . Fick's Law Plot of Desorption Diffusion (30 degrees C)
of Supercritical Carbon Dioxide from Polymeric Materials:
PVC (0089d)**



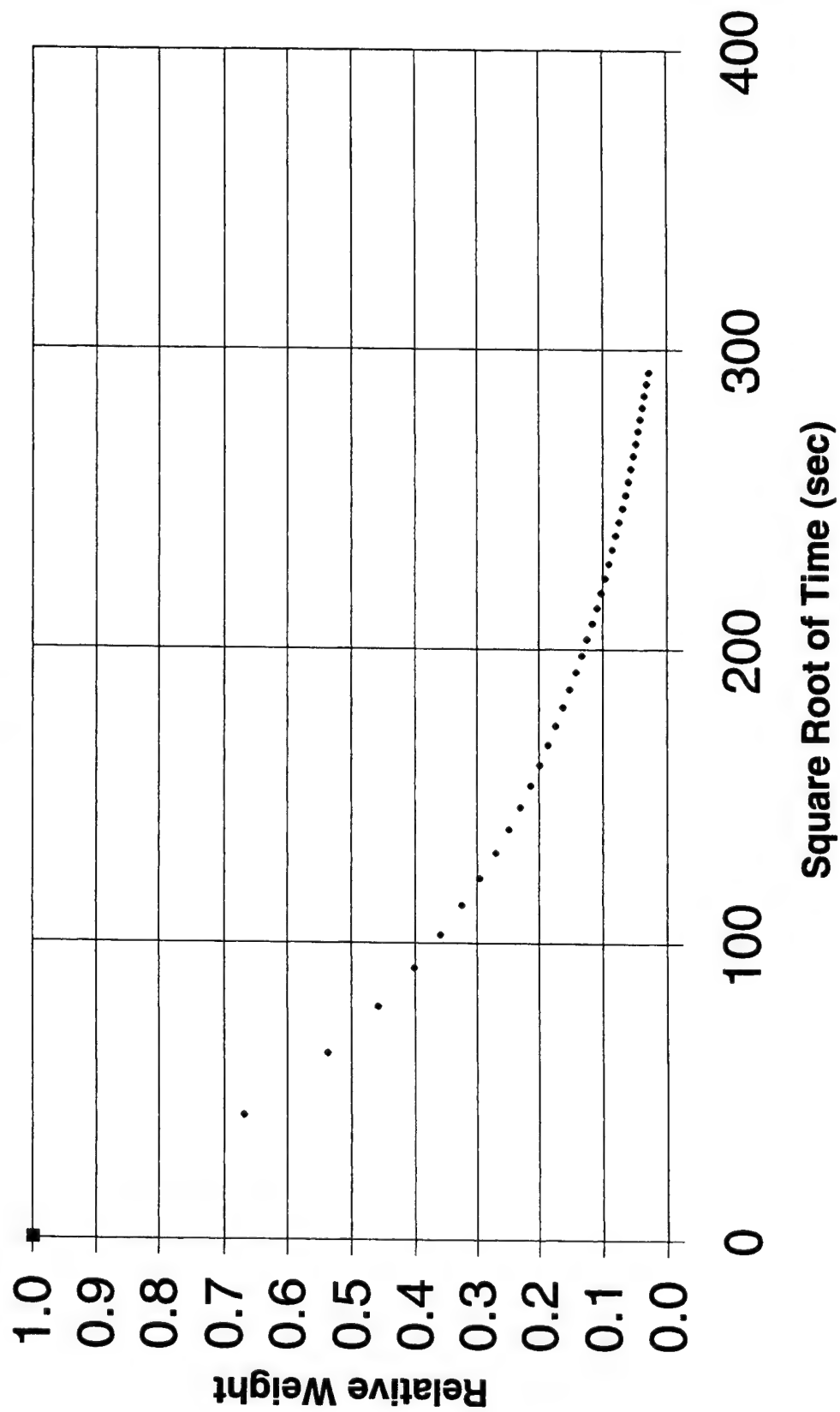
**Figure . Desorption Diffusion (30 degrees C) of Supercritical
Carbon Dioxide from Polymeric Materials: PVC (0089d)**



**Figure . Desorption Diffusion (30 degrees C) of Supercritical
Carbon Dioxide from Polymeric Materials: PVC (0089d)**



**Figure . Fick's Law Plot of Desorption Diffusion (30 degrees C) of
Supercritical Carbon Dioxide from Polymeric Materials:
PVC (0089d)**



TGA Time, min A	Temp., deg C B	TGA Wt., mg C	TGA Time, sec D	Adjusted Time, sec E	Adjusted Time, hr F	SQRT Adj. Time, sec G	Wt. Loss, % H	Fractional Wt. Loss I	Wt. @ Zero Time, mg J	Wt. @ Zero Time, % K	TGA Dry Wt., mg L	Adjustment to TGA Time, sec M	Hardness Scale N
18.250	30.006	106.287	1095.000	1755.000	0.488	41.89	0.986	0.669	106.80	1.474	105.249	660	Shore D
54.921	30.000	106.081	3295.260	3955.260	1.099	62.89	0.791	0.536					
91.612	30.000	105.960	5496.720	6156.720	1.710	78.46	0.676	0.458					
128.295	30.000	105.872	7697.700	8357.700	2.322	91.42	0.592	0.402					
164.970	30.000	105.806	9898.200	10558.200	2.933	102.75	0.529	0.359					
201.653	30.000	105.752	12099.180	12759.180	3.544	112.96	0.478	0.324					
238.372	30.000	105.707	14302.320	14962.320	4.156	122.32	0.435	0.295					
275.077	30.000	105.668	16504.620	17164.620	4.768	131.01	0.398	0.270					
311.812	30.000	105.635	18708.720	19368.720	5.380	139.17	0.367	0.249					
348.518	30.000	105.606	20911.080	21571.080	5.992	146.87	0.339	0.230					
385.241	30.000	105.580	23114.460	23774.460	6.604	154.19	0.314	0.213					
421.921	30.000	105.558	25315.260	25975.260	7.215	161.17	0.294	0.199					
458.658	30.000	105.537	27519.480	28179.480	7.828	167.87	0.274	0.186					
495.375	30.000	105.518	29722.500	30382.500	8.440	174.31	0.256	0.173					
532.075	30.000	105.501	31924.500	32584.500	9.051	180.51	0.239	0.162					
568.747	30.000	105.484	34124.820	34784.820	9.662	186.51	0.223	0.152					
605.434	30.000	105.469	36326.040	36986.040	10.274	192.32	0.209	0.142					
642.127	30.001	105.455	38527.820	39187.820	10.885	197.96	0.196	0.133					
678.846	30.000	105.442	40730.760	41390.760	11.497	203.45	0.183	0.124					
715.548	30.000	105.429	42932.880	43592.880	12.109	208.79	0.171	0.116					
752.259	30.001	105.418	45135.540	45795.540	12.721	214.00	0.161	0.109					
788.954	30.000	105.408	47337.240	47997.240	13.333	219.08	0.151	0.103					
825.628	30.000	105.398	49537.680	50197.680	13.944	224.05	0.142	0.096					
862.321	30.000	105.389	51739.260	52399.260	14.555	228.91	0.133	0.090					
899.035	30.000	105.381	53942.100	54602.100	15.167	233.67	0.125	0.085					
935.722	30.000	105.372	56143.320	56803.320	15.779	238.33	0.117	0.079					
972.398	30.000	105.364	58343.880	59003.880	16.390	242.91	0.109	0.074					
1009.092	30.000	105.356	60545.520	61205.520	17.002	247.40	0.102	0.069					
1045.810	30.000	105.349	62748.600	63408.600	17.614	251.81	0.095	0.064					
1082.522	30.000	105.342	64951.320	65611.320	18.225	256.15	0.088	0.060					
1119.216	30.000	105.336	67152.960	67812.960	18.837	260.41	0.083	0.056					
1155.910	30.000	105.330	69354.600	70014.600	19.449	264.60	0.077	0.052					
1192.602	30.000	105.324	71556.120	72216.120	20.060	268.73	0.071	0.048					
1229.303	30.000	105.318	73758.180	74418.180	20.672	272.80	0.066	0.044					
1266.001	30.000	105.313	75960.060	76620.060	21.283	276.80	0.061	0.041					
1302.711	30.000	105.308	78162.660	78822.660	21.895	280.75	0.056	0.038					
1339.419	30.000	105.303	80365.140	81025.140	22.507	284.65	0.051	0.035					
1376.127	30.000	105.298	82567.620	83227.620	23.119	288.49	0.047	0.032					
1412.846	30.000	105.292	84770.760	85430.760	23.731	292.29	0.041	0.028					

Formulae Used for Analysis of Data

Uppercase letters refer to columns

Lowercase n refers to row, beginning with n=4

Dn = (An * 60)

En = (Dn + M4)

Fn = (En / 3600)

Gn = SQRT (En)

Hn = (((Cn - L4) / L4) * 100)

In = ((Cn - L4) / (J4 - L4))

K4 = (((J4 - L4) / L4) * 100)

N16 = (((N12 - N8) / N8) * 100)

Source binary TA data file : pvc0089d.01

14 lines in the parameter block

3 channels of data

Run 23

Module TGA Aluminum Pans

Sample PVC SCCO2 0089D

Size 106.469 mg

Method DESORPTION-Isothermal

Operator WJS

Comment Disk: 4x0.03 in. HP@1400x50 Dry Wt, TGA: 105.249 ET: 11:30

Nsig 3

Sig1 Time (min)

Sig2 Temperature (°C)

Sig3 Weight (mg)

Kcell 1.0000

Date 29-Mar-00

Time 14:01

Pre Exposure

Hardness

73.4

Post Desorption

Hardness

71.5

Change in

Hardness, %

-2.59

Blank

FIGURE . CHEMICAL-MATERIAL INTERACTION DATA SET:**Supercritical Carbon Dioxide and Polyvinyl Chloride****PVC****Sorption, Desorption Diffusion, and Indentation Data Sets****Material Data**

Test Reference Number:	<u>03-1-3</u>	TGA Filename:	<u>pvc0110z</u>
Property Test Specification:	ASTM D471/D543		
Material Name:	<u>Polyvinyl Chloride</u>	Material Code:	<u>PVC</u>
Material Supplier:	<u>Harbor City Plastics</u>	Material Class:	<u>TP</u>
Monomer Source:	<u>Georgia Gulf</u>	Base Polymer (Lot. No.):	<u>(4576T1)</u>
Exposure Liquid:	<u>Supercritical Carbon Dioxide</u>	Replicate Number:	<u>3</u>

Pre-Exposure Data

Measured Diameter (mm):	<u>11.01</u>	<u>11</u>	<u>11.07</u>	<u>10.99</u>	
Mean Diameter:	<u>11.005</u>				95% Confidence Level (CL): <u>0.057</u>
Measured Thickness (mils):	<u>42.60</u>	<u>43.00</u>	<u>41.90</u>	<u>41.10</u>	
Mean Thickness:	<u>42.150</u>				95% Confidence Level (CL): <u>1.328</u>
Initial Sample Weight (mg):	<u>100.640</u>				
Initial Durometer Hardness:	<u>ND</u>	Scale: SHORE	<u>D</u>		

Sample Exposure Data

Exposure Date:	<u>04/19/00</u>	Time:	<u>08:37:00</u>	
Removal Date:	<u>04/19/00</u>	Time:	<u>08:52:00</u>	
Total Exposure Time (h:m:s):	<u>00:15:00</u>	Weight of Sample After Exposure (mg):	<u>102.30</u>	
Weight Gain (mg):	<u>1.66</u>	Percent Weight Gain:	<u>1.65</u>	
Final Durometer Hardness After Desorption:	<u>ND</u>	Percent Hardness Change:	<u>ND</u>	

Desorption Experiment

Mean Temperature of Desorption Experiment (setpoint = 30 deg C):	<u>30.000</u>	95% CL:	<u>0.0007</u>
Time Lapse Between Sample Exposure and Sample Desorption (sec):			<u>450</u>
Equilibrium Weight of Desorbed Sample at 30 deg C (mg):			<u>100.660</u>
Sample Extracted (mg):	<u>-0.02</u>	Solubility Corrected for Extractables (mg):	<u>1.66</u>
Sample Extracted (%):	<u>-0.02</u>	Solubility Corrected for Extractables (%):	<u>1.65</u>

Diffusion Coefficient Data: Fick's Law

High Concentration Diffusion Coefficient (cm ² /sec):	<u>1.2995E-07</u>
Range Including 0,1 Intercept, Relative Weight Fraction:	<u>1.00 - 0.70</u>
Linear Range of Desorption, Relative Weight Fraction:	<u>0.83 - 0.70</u>
Slope: <u>-7.5987E-03</u>	X-axis Intercept: <u>1.3033E+02</u>
R Square: <u>0.99801</u>	Y-axis Intercept: <u>9.9033E-01</u>

Low Concentration Diffusion Coefficient (cm ² /sec):	<u>3.2042E-10</u>
Linear Range of Desorption, Relative Weight Fraction:	<u>0.06 - 0.01</u>
Slope: <u>-3.7732E-04</u>	X-axis Intercept: <u>4.6480E+02</u>
R Square: <u>0.99010</u>	Y-axis Intercept: <u>1.7538E-01</u>

Wt. @ Zero Time, mg K 102.30	Wt. @ Zero Time, % L 1.649	Adjustment to TGA Time, sec M 450	Hardness Shore Scale N D
TGA Dry Wt., mg 100.640	Equil. Wt. Of Desorb. Sample 100.66	Min. Wt. Used For FDC, mg. 100.640	Pre Exposure Hardness ND
High Conc. DC, cm2/sec 1.2995E-07	Low Conc. DC, cm2/sec 3.2042E-10	Total Liquid Sorbed, mg. 1.660	Post Desorption Hardness ND
R Square 0.99801	R Square 0.99010		Change in Hardness, % ND
X Intercept 130.33	X Intercept 464.8		Mean Thickness, cm. 0.1071
Y Intercept 0.99033	Y Intercept 0.17538		
Y Intercept as Wt., mg. 101.310	X Intercept as Time, hrs. 60.0	X Intercept as Time, min. 360.1	pvc0110z X Intercept as Time, days 2.5

TEMPERATURE STATISTICS

<i>Column1</i>		Max. TGA Wt., (orig data file) 102.014	TGA Wt. At 20 min. Adjustment 101.848
Mean	30.0000917	Sorption @ 7-12 min., mg	Sorption @ 20 min., mg
Standard Error	0.000342257	1.37	1.21
Median	30		
Mode	30	Sorption @ 7-12	Sorption @ 20
Standard Deviation	0.020155416	min., %	min., %
Sample Variance	0.000406241	1.37	1.20
Kurtosis	596.0945094		
Skewness	-16.45057779	Rel. Error (%) of	Rel. Error (%) of
Range	0.948	7-12 min. Sorp.	20 min. Sorp
Minimum	29.291	-17.2	-27.2
Maximum	30.239		
Sum	104040.318		
Count	3468		
Confidence Level(95.0%)	0.000671045		

DIAMETER STATISTICS

<i>Column1</i>	
Mean	11.0175
Standard Error	0.01796988
Median	11.005
Mode	#N/A
Standard Deviation	0.03593976
Sample Variance	0.00129167
Kurtosis	3.01436004
Skewness	1.6963868
Range	0.08
Minimum	10.99
Maximum	11.07
Sum	44.07
Count	4
Confidence Level(95.0%)	0.05718824

THICKNESS STATISTICS

<i>Column1</i>	
Mean	42.15
Standard Error	0.4173328
Median	42.25
Mode	#N/A
Standard Deviation	0.8346656
Sample Variance	0.69666667
Kurtosis	-1.2583503
Skewness	-0.5365585
Range	1.9
Minimum	41.1
Maximum	43
Sum	168.6
Count	4
Confidence Level(95.0%)	1.32814048

HIGH CONCENTRATION DIFFUSION COEFFICIENT

pvc0110z

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.999006486
R Square	0.998013959
Adjusted R Square	0.997957215
Standard Error	0.002478215
Observations	37

ANOVA

	df	SS	MS	F	Significance F
Regression	1	0.108017579	0.108017579	17587.9965	6.95037E-49
Residual	35	0.000214954	6.14155E-06		
Total	36	0.108232533			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	0.990325638	0.001773751	558.3229407	1.0143E-70	0.986724729	0.993926548
X Variable 1	-0.007598731	5.72971E-05	-132.6197438	6.9504E-49	-0.00771505	-0.007482411

LOW CONCENTRATION DIFFUSION COEFFICIENT

SUMMARY OUTPUT

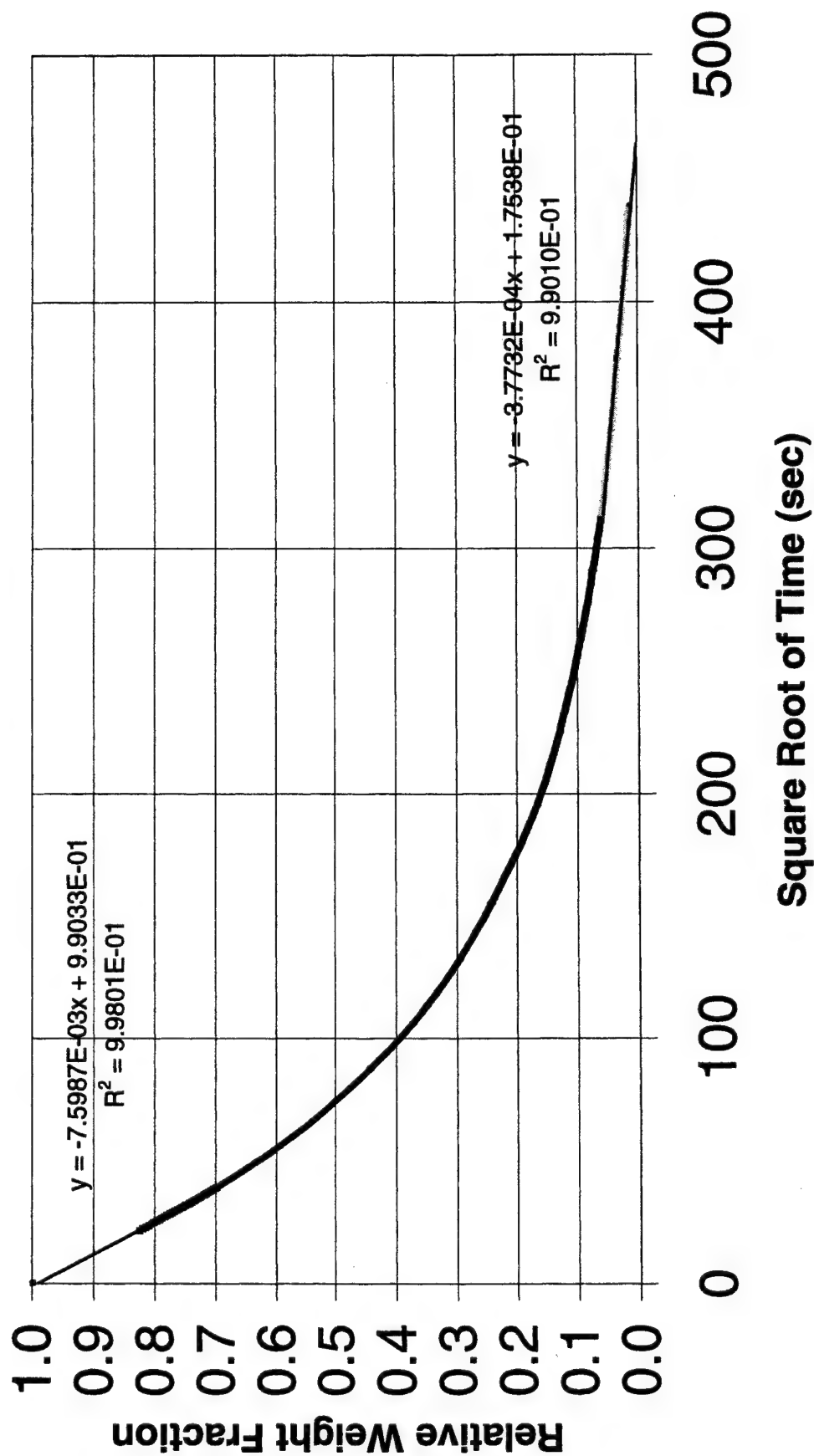
Regression Statistics	
Multiple R	0.995040016
R Square	0.990104633
Adjusted R Square	0.990085785
Standard Error	0.001369069
Observations	527

ANOVA

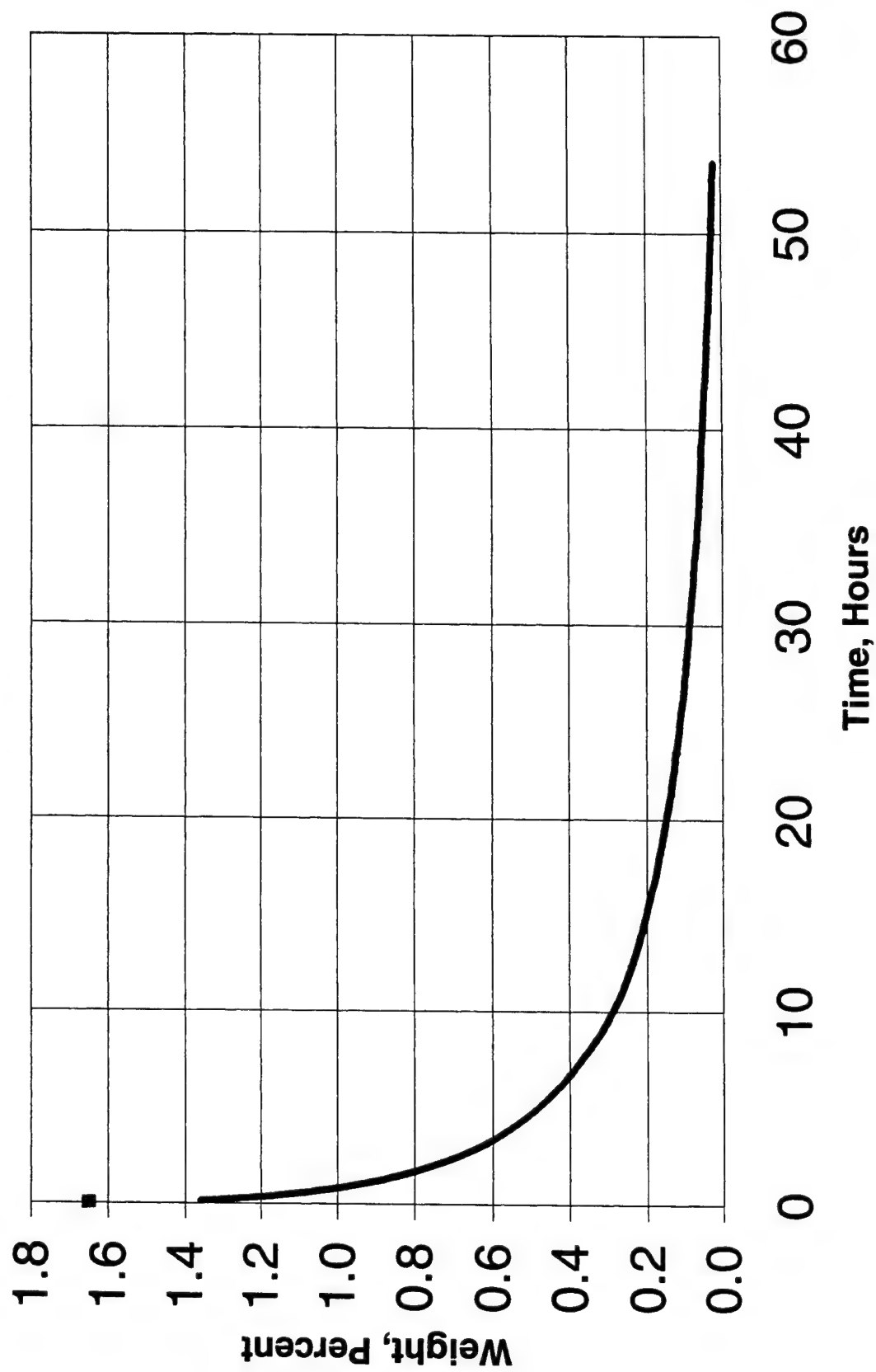
	df	SS	MS	F	Significance F
Regression	1	0.098459911	0.098459911	52530.1336	0
Residual	525	0.000984034	1.87435E-06		
Total	526	0.099443945			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	0.175377777	0.000627973	279.2759937	0	0.17414413	0.176611424
X Variable 1	-0.000377322	1.6463E-06	-229.1945321	0	-0.000380556	-0.000374088

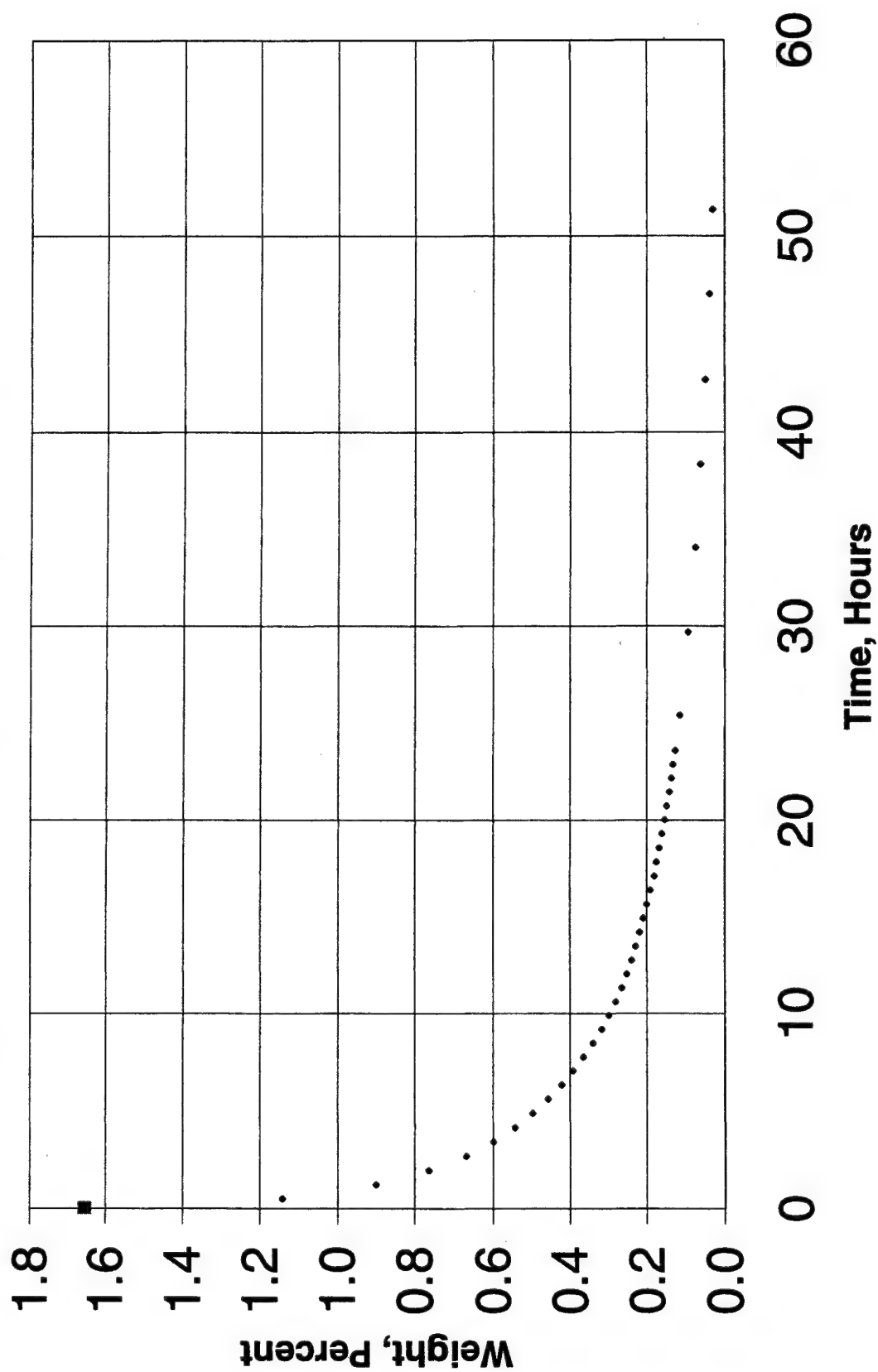
**Figure . Fick's Law Plot of Desorption Diffusion (30 degrees C)
of Supercritical Carbon Dioxide from Polymeric Materials:
PVC (0110z)**



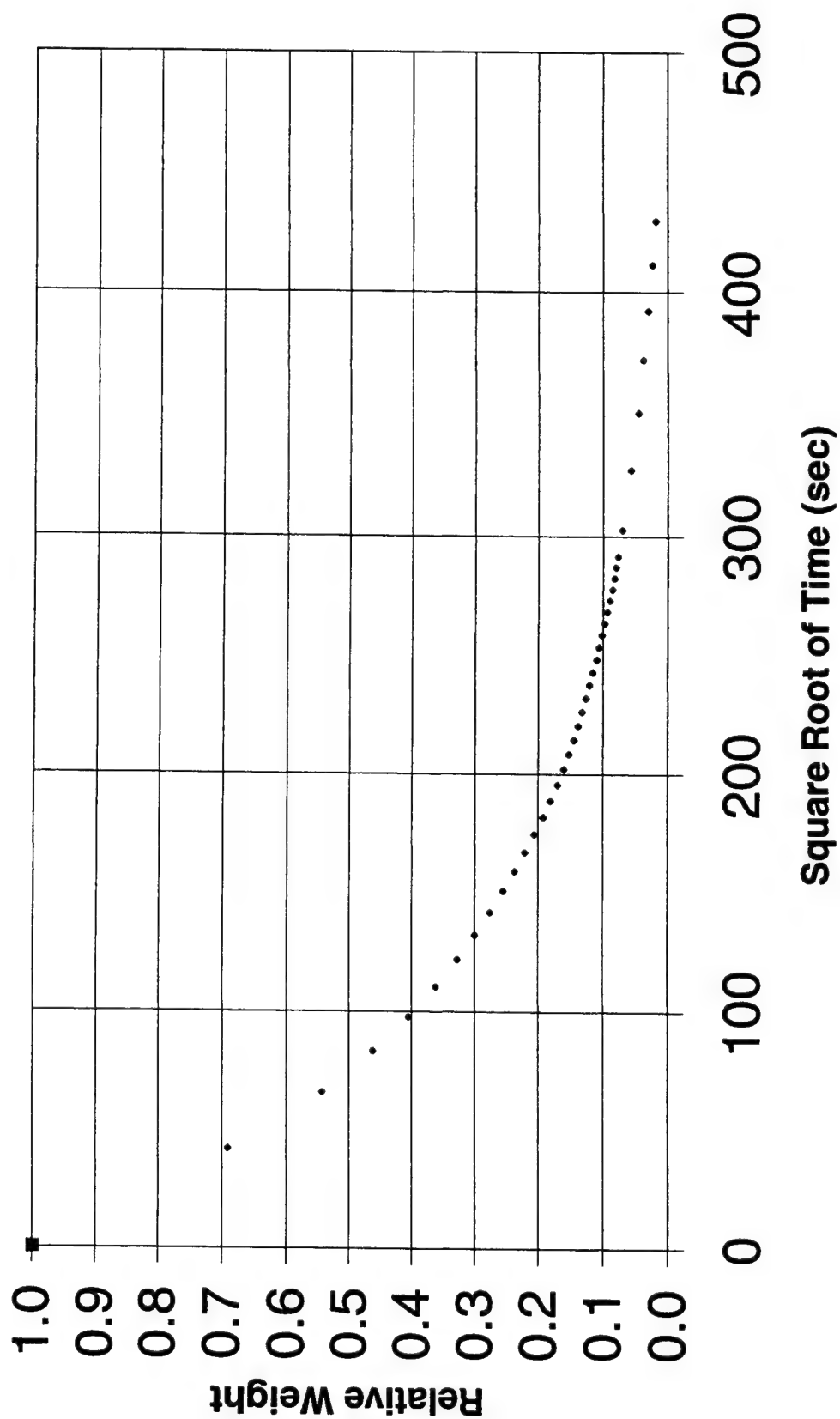
**Figure . Desorption Diffusion (30 degrees C) of Supercritical
Carbon Dioxide from Polymeric Materials: PVC (0110z)**



**Figure . Desorption Diffusion (30 degrees C) of Supercritical
Carbon Dioxide from Polymeric Materials: PVC (0110z)**



**Figure . Fick's Law Plot of Desorption Diffusion (30 degrees C) of
Supercritical Carbon Dioxide from Polymeric Materials:
PVC (0110z)**



TGA Time, min	Temp., deg C	TGA Wt., mg	TGA Time, sec	Adjusted Time, sec	Adjusted Time, hr	SQRT Adj. Time, sec	Wt. Loss, %	Fractional Wt. Loss	Wt. @ Zero Time, mg	Wt. @ Zero Time, %	TGA Dry Wt., mg	Adjustment to TGA Time, sec	Hardness Scale
21.583	29.998	101.785	1294.980	1744.980	0.485	41.77	1.143	0.691	102.30	1.654	100.635	450	Shore D
64.916	30.000	101.540	3894.960	4344.960	1.207	65.92	0.899	0.544					
108.255	30.000	101.404	6495.300	6945.300	1.929	83.34	0.764	0.462					
151.603	30.000	101.309	9096.180	9546.180	2.652	97.70	0.670	0.405					
195.067	30.000	101.238	11704.020	12154.020	3.376	110.25	0.599	0.362					
238.458	30.000	101.181	14307.480	14757.480	4.099	121.48	0.543	0.328					
281.835	30.000	101.134	16910.100	17360.100	4.822	131.76	0.496	0.300					
325.213	30.000	101.094	19512.780	19962.780	5.545	141.29	0.456	0.276					
368.638	30.000	101.059	22118.280	22568.280	6.269	150.23	0.421	0.255					
412.093	30.000	101.030	24725.580	25175.580	6.993	158.67	0.393	0.237					
455.530	30.000	101.003	27331.800	27781.800	7.717	168.68	0.366	0.221					
498.926	30.000	100.978	29935.560	30385.560	8.440	174.31	0.341	0.206					
542.294	30.000	100.955	32537.640	32987.640	9.163	181.62	0.318	0.192					
585.684	30.000	100.936	35141.040	35591.040	9.886	188.66	0.299	0.181					
629.093	30.001	100.918	37745.580	38195.580	10.610	195.44	0.281	0.170					
672.489	30.001	100.902	40349.340	40799.340	11.333	201.99	0.265	0.160					
715.862	30.000	100.889	42951.720	43401.720	12.056	208.33	0.252	0.153					
759.199	30.000	100.876	45551.940	46001.940	12.778	214.48	0.239	0.145					
802.569	30.000	100.865	48154.140	48604.140	13.501	220.46	0.229	0.138					
846.006	30.000	100.855	50760.360	51210.360	14.225	226.30	0.219	0.132					
889.404	30.000	100.845	53364.240	53814.240	14.948	231.98	0.209	0.126					
932.792	30.000	100.836	55967.520	56417.520	15.672	237.52	0.200	0.121					
976.171	30.000	100.827	58570.260	59020.260	16.395	242.94	0.191	0.115					
1019.537	30.000	100.817	61172.220	61622.220	17.117	248.24	0.181	0.109					
1062.936	30.000	100.811	63776.160	64226.160	17.841	253.43	0.175	0.106					
1106.294	30.000	100.804	66377.640	66827.640	18.563	258.51	0.168	0.102					
1149.658	30.000	100.797	68979.480	69429.480	19.286	263.49	0.161	0.097					
1193.003	30.000	100.790	71580.180	72030.180	20.008	268.38	0.154	0.093					
1236.350	30.000	100.784	74181.000	74631.000	20.731	273.19	0.148	0.089					
1279.745	30.000	100.777	76784.700	77234.700	21.454	277.91	0.141	0.085					
1323.091	30.000	100.772	79385.460	79835.460	22.177	282.55	0.136	0.082					
1366.445	30.000	100.768	81986.700	82436.700	22.899	287.12	0.132	0.080					
1409.801	30.001	100.762	84588.060	85038.060	23.622	291.61	0.126	0.076					
1519.198	30.000	100.751	91151.880	91601.880	25.445	302.66	0.115	0.070					
1773.999	30.000	100.729	106439.940	106889.940	29.692	326.94	0.093	0.056					
2034.000	30.000	100.710	122040.000	122490.000	34.025	349.99	0.075	0.045					
2294.001	30.000	100.697	137640.060	138090.060	38.358	371.60	0.062	0.037					
2554.020	30.000	100.684	153241.200	153691.200	42.692	392.03	0.049	0.029					
2814.018	30.000	100.673	168841.080	169291.080	47.025	411.45	0.038	0.023					
3074.020	30.000	100.665	184441.200	184891.200	51.359	429.99	0.030	0.018					

Pre Exposure
Hardness
ND

Post Desorption
Hardness
ND

Change in
Hardness, %
#VALUE!

Formulae Used for Analysis of Data

Uppercase letters refer to columns

Lowercase n refers to row, beginning with n=4

$Dn = (An * 60)$

$En = (Dn + M4)$

$Fn = (En / 3600)$

$Gn = SQRT(En)$

$Hn = (((Cn - L4) / L4) * 100)$

$In = (((J4 - L4) / (J4 - L4))$

$K4 = (((J4 - L4) / L4) * 100)$

$N16 = (((N12 - N8) / N8) * 100)$

Source binary TA data file : pvc0110z.01*

14 lines in the parameter block

3 channels of data

Run 30

Module TGA Aluminum Pans

Sample PVC SCO2 PVC0110Z

Size 102.014 mg

Method DESORPTION-Isothermal

Operator WJS

Comment Disk: 4x0.03 in., HP@1400x50, Dry: M-100.69 TG-100.635 ET-7:30

Nsig 3

Sig1 Time (min)

Sig2 Temperature (°C)

Sig3 Weight (mg)

Kcell 1.0000

Date 19-Apr-00

Time 09:00

Blank

FIGURE . CHEMICAL-MATERIAL INTERACTION DATA SET:**Supercritical Carbon Dioxide and Polyimide****PIF****Sorption, Desorption Diffusion, and Indentation Data Sets****Material Data**

Test Reference Number:	<u>15-1-1</u>	TGA Filename:	<u>pif0151z</u>
Property Test Specification:	ASTM D471/D543		
Material Name:	<u>Polyimide</u>	Material Code:	<u>PIF</u>
Material Supplier:	<u>Goodfellow Cambridge Ltd.</u>	Material Class:	<u>Blank</u>
Monomer Source:	<u>Unknown</u>	Base Polymer (Lot. No.):	<u>Upilex</u>
Exposure Liquid:	<u>Supercritical Carbon Dioxide</u>	Replicate Number:	<u>1</u>

Pre-Exposure Data

Measured Diameter (mm):	<u>8.42</u>	<u>8.42</u>	<u>8.55</u>	<u>8.44</u>	
Mean Diameter:	<u>8.430</u>				95% Confidence Level (CL): <u>0.099</u>
Measured Thickness (mils):	<u>10.00</u>	<u>11.90</u>	<u>11.00</u>	<u>10.30</u>	
Mean Thickness:	<u>10.800</u>				95% Confidence Level (CL): <u>1.344</u>
Initial Sample Weight (mg):	<u>19.260</u>				
Initial Durometer Hardness:	<u>82.5</u>	Scale: SHORE	<u>D</u>		

Sample Exposure Data

Exposure Date:	<u>05/30/00</u>	Time:	<u>10:55:00</u>	
Removal Date:	<u>05/30/00</u>	Time:	<u>11:10:00</u>	
Total Exposure Time (h:m:s):	<u>00:15:00</u>	Weight of Sample After Exposure (mg):	<u>19.30</u>	
Weight Gain (mg):	<u>0.04</u>	Percent Weight Gain:	<u>0.21</u>	
Final Durometer Hardness After Desorption:	<u>82.2</u>	Percent Hardness Change:	<u>-0.4</u>	

Desorption Experiment

Mean Temperature of Desorption Experiment (setpoint = 30 deg C):	<u>30.001</u>	95% CL:	<u>0.0005</u>
Time Lapse Between Sample Exposure and Sample Desorption (sec):			<u>430</u>
Equilibrium Weight of Desorbed Sample at 30 deg C (mg):			<u>19.090</u>
Sample Extracted (mg):	<u>0.17</u>	Solubility Corrected for Extractables (mg):	<u>0.21</u>
Sample Extracted (%):	<u>0.88</u>	Solubility Corrected for Extractables (%):	<u>1.09</u>

Diffusion Coefficient Data: Fick's Law

High Concentration Diffusion Coefficient (cm ² /sec):	<u>1.8434E-09</u>
Range Including 0,1 Intercept, Relative Weight Fraction:	<u>1.00 - 0.90</u>
Linear Range of Desorption, Relative Weight Fraction:	<u>0.95 - 0.90</u>
Slope: <u>-3.5321E-03</u>	X-axis Intercept: <u>2.8530E+02</u>
R Square: <u>0.86086</u>	Y-axis Intercept: <u>1.0077E+00</u>

Low Concentration Diffusion Coefficient (cm ² /sec):	<u>1.1647E-10</u>
Linear Range of Desorption, Relative Weight Fraction:	<u>0.05 - 0.00</u>
Slope: <u>-8.8786E-04</u>	X-axis Intercept: <u>4.0875E+02</u>
R Square: <u>0.99548</u>	Y-axis Intercept: <u>3.6291E-01</u>

Wt. @ Zero Time, mg K 19.30	Wt. @ Zero Time, % L 0.208	Adjustment to TGA Time, sec M 430	Hardness Shore Scale N D
TGA Dry Wt., mg 19.260	Equil. Wt. Of Desorb. Sample 19.09	Min. Wt. Used For FDC, mg. 19.090	Pre Exposure Hardness 82.5
High Conc. DC, cm2/sec 1.8434E-09	Low Conc. DC, cm2/sec 1.1647E-10	Total Liquid Sorbed, mg. 0.040	Post Desorption Hardness 82.2
R Square 0.86086	R Square 0.99548		Change in Hardness, % -0.4
X Intercept 285.30	X Intercept 408.7		Mean Thickness, cm. 0.0274
Y Intercept 1.00772	Y Intercept 0.36291		
Y Intercept as Wt., mg. 19.449	X Intercept as Time, hrs. 46.4	X Intercept as Time, min. 278.5	pif0151z X Intercept as Time, days 1.9

TEMPERATURE STATISTICS

<i>Column1</i>		Max. TGA Wt., (orig data file) 19.291	TGA Wt. At 20 min. Adjustment 19.268
Mean	30.00114585	Sorption @ 7-12 min., mg	Sorption @ 20 min., mg
Standard Error	0.00026329	0.03	0.01
Median	30.001		
Mode	29.998	Sorption @ 7-12	Sorption @ 20
Standard Deviation	0.015213991	min., %	min., %
Sample Variance	0.000231466	0.16	0.04
Kurtosis	693.6462665		
Skewness	-20.3095439	Rel. Error (%) of	Rel. Error (%) of
Range	0.676	7-12 min. Sorp.	20 min. Sorp
Minimum	29.428	-22.5	-80.0
Maximum	30.104		
Sum	100173.826		
Count	3339		
Confidence Level(95.0%)	0.000516227		

DIAMETER STATISTICS

<i>Column1</i>	
Mean	8.4575
Standard Error	0.03119161
Median	8.43
Mode	8.42
Standard Deviation	0.06238322
Sample Variance	0.00389167
Kurtosis	3.50405568
Skewness	1.86901672
Range	0.13
Minimum	8.42
Maximum	8.55
Sum	33.83
Count	4
Confidence Level(95.0%)	0.09926572

ND/value
ND/value
A/D

THICKNESS STATISTICS

<i>Column1</i>	
Mean	10.8
Standard Error	0.42229532
Median	10.65
Mode	#N/A
Standard Deviation	0.84459063
Sample Variance	0.71333333
Kurtosis	-0.8058782
Skewness	0.77679617
Range	1.9
Minimum	10
Maximum	11.9
Sum	43.2
Count	4
Confidence Level(95.0%)	1.34393343

Upilex
pif0151z

HIGH CONCENTRATION DIFFUSION COEFFICIENT

pif0151z

SUMMARY OUTPUT

<i>Regression Statistics</i>	
Multiple R	0.927826825
R Square	0.860862618
Adjusted R Square	0.845402909
Standard Error	0.011130957
Observations	11

ANOVA

	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	1	0.006899181	0.006899181	55.68427	3.84247E-05
Residual	9	0.001115084	0.000123898		
Total	10	0.008014265			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>
Intercept	1.00772173	0.010826876	93.07594323	9.6714E-15	0.983229616	1.032213845
X Variable 1	-0.00353209	0.000473332	-7.462189357	3.8425E-05	-0.004602842	-0.002461339

LOW CONCENTRATION DIFFUSION COEFFICIENT

SUMMARY OUTPUT

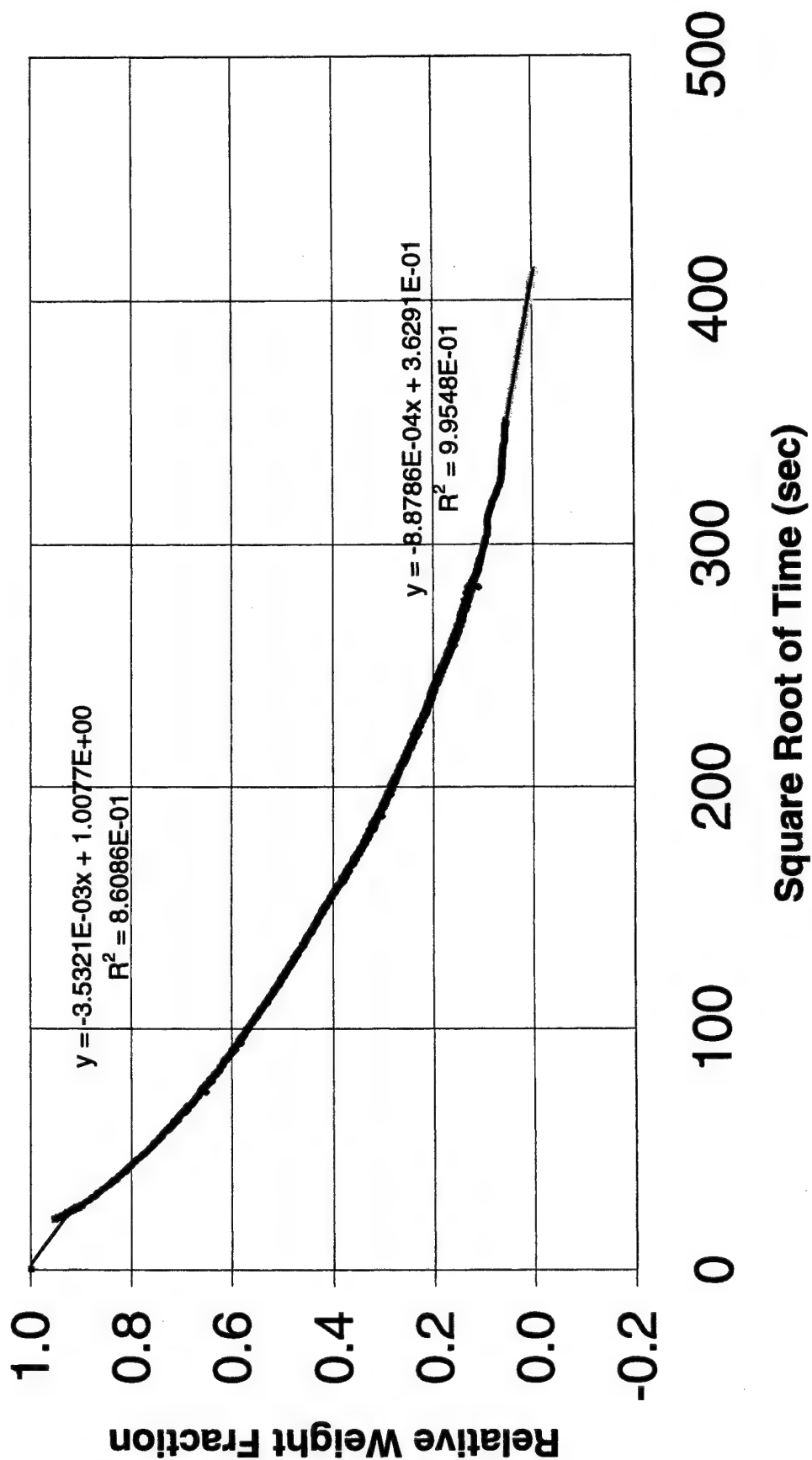
<i>Regression Statistics</i>	
Multiple R	0.997739896
R Square	0.9954849
Adjusted R Square	0.995467263
Standard Error	0.001053154
Observations	258

ANOVA

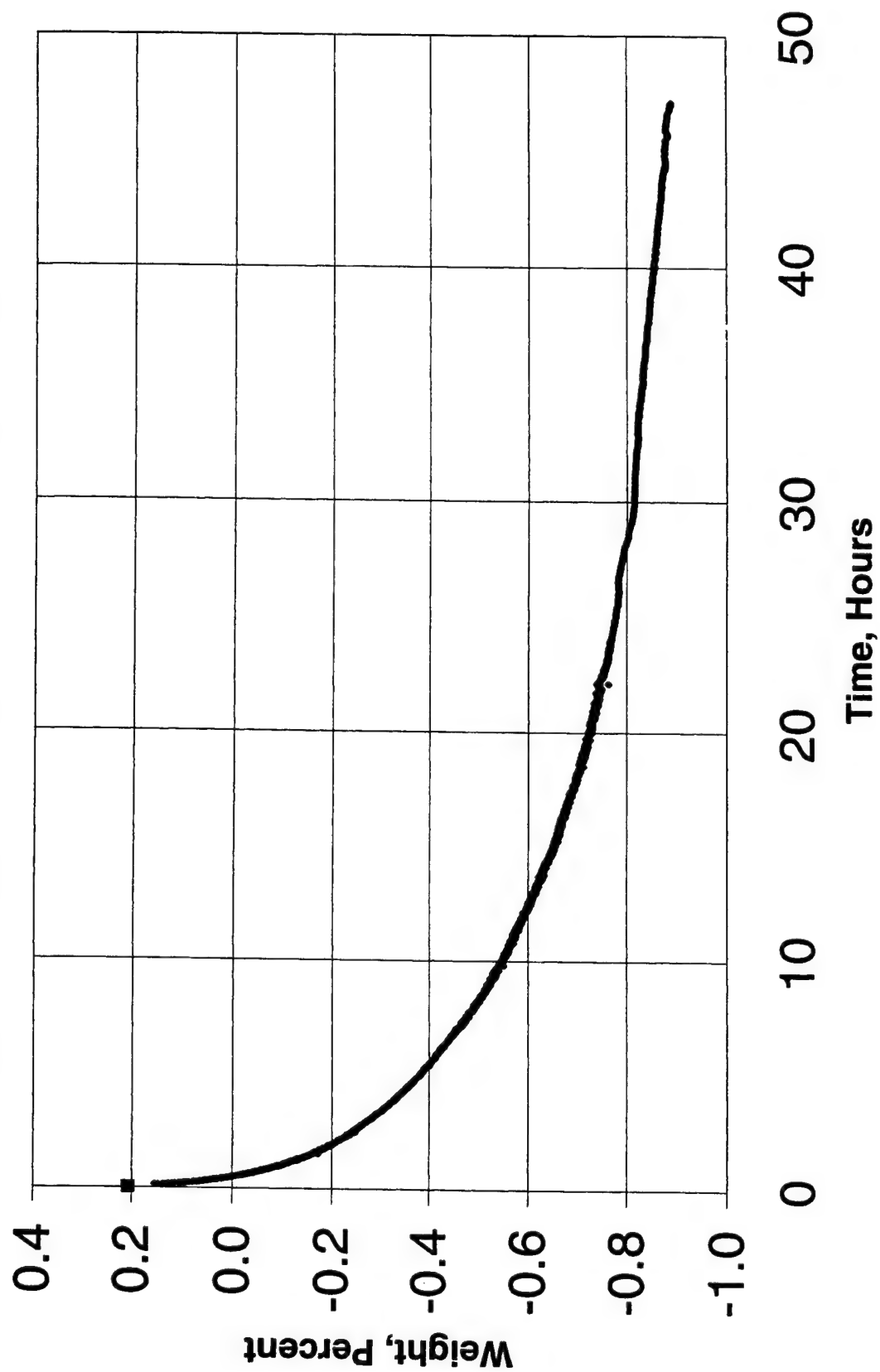
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	1	0.062602448	0.062602448	56442.6332	3.1318E-302
Residual	256	0.000283938	1.10913E-06		
Total	257	0.062886387			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>
Intercept	0.36290949	0.001430813	253.6386217	0	0.360091826	0.365727153
X Variable 1	-0.000887858	3.73714E-06	-237.5765839	3.132E-302	-0.000895217	-0.000880498

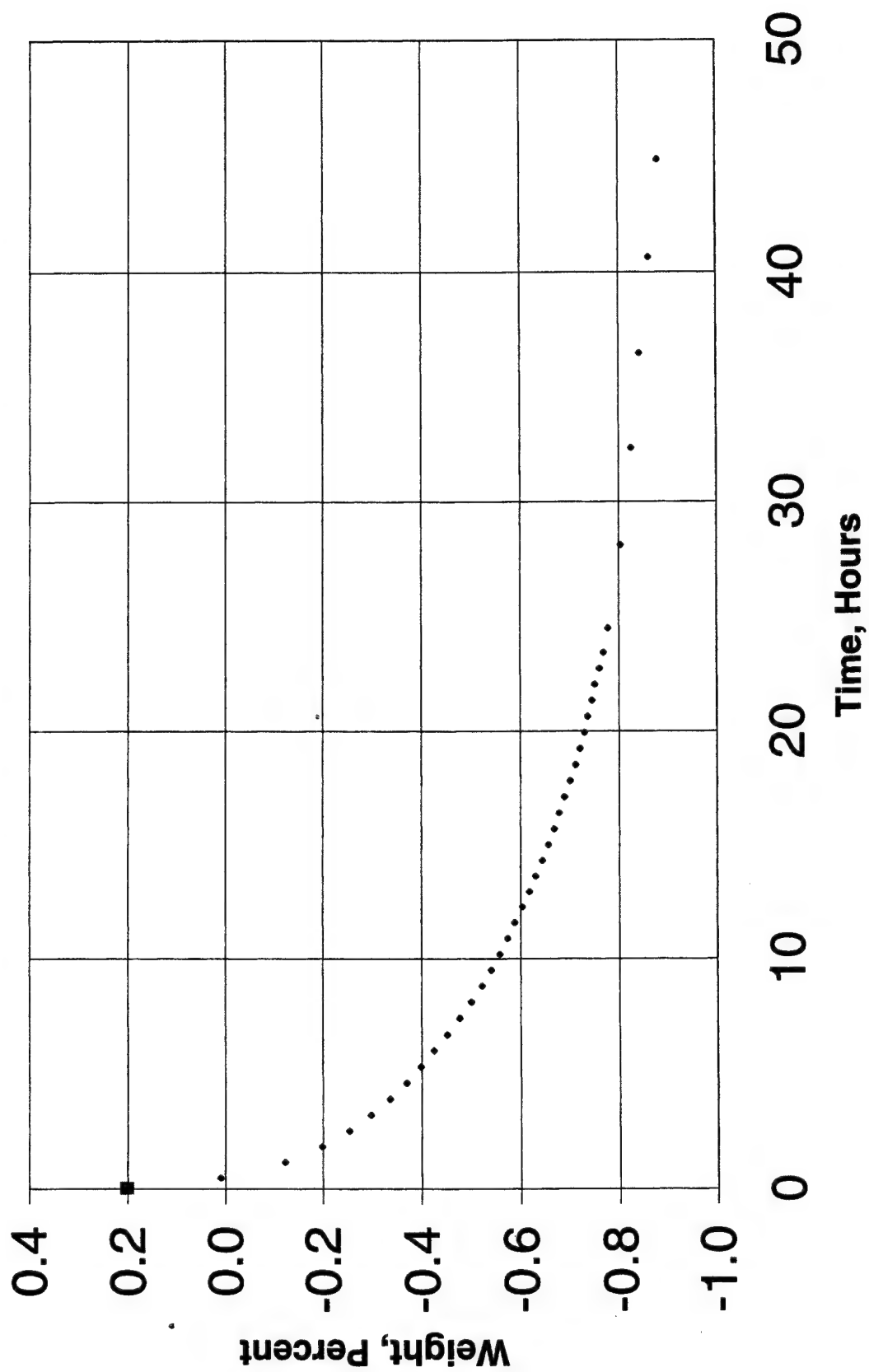
**Figure . Fick's Law Plot of Desorption Diffusion (30 degrees C)
of Supercritical Carbon Dioxide from Polymeric Materials:
PIF (0151z)**



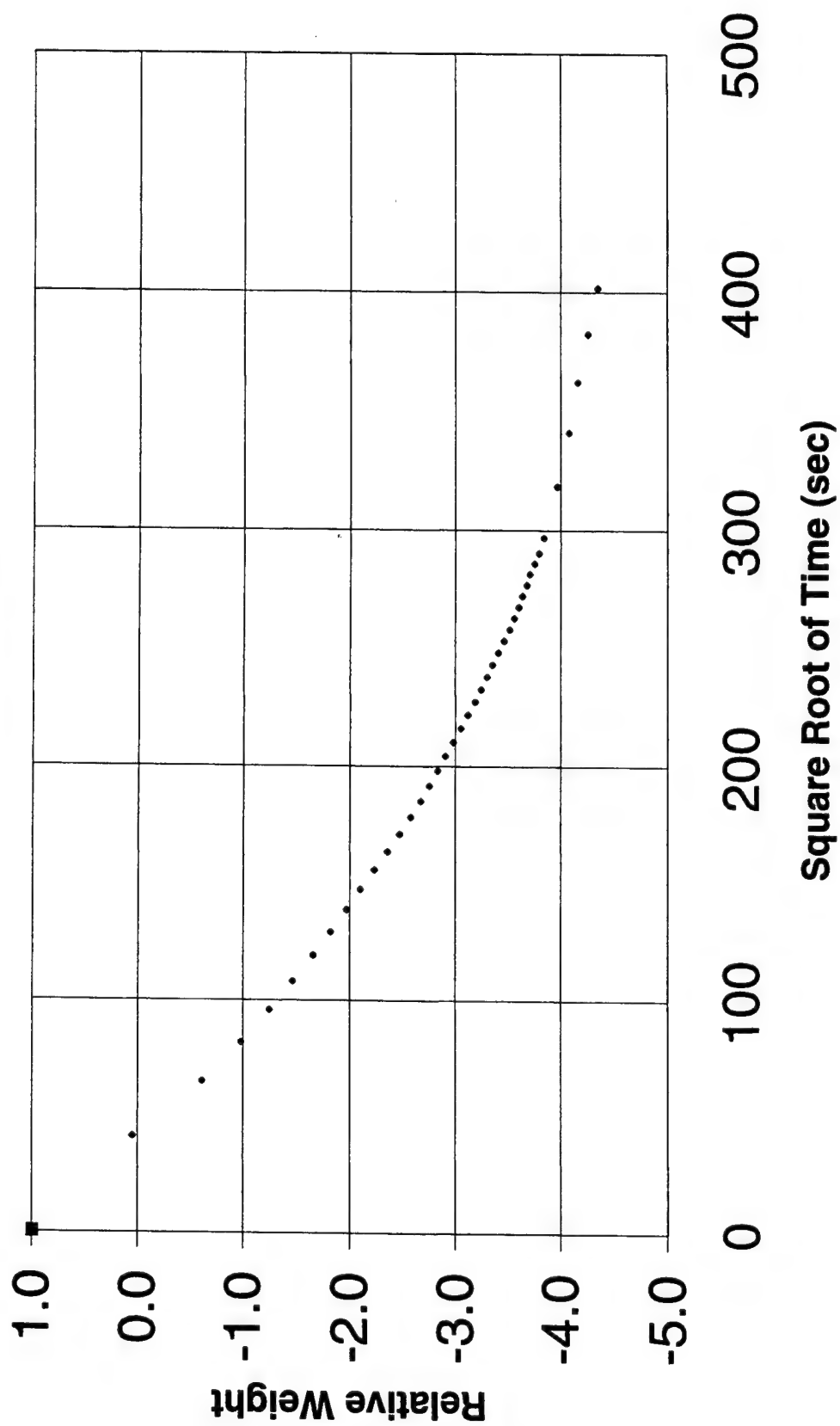
**Figure . Desorption Diffusion (30 degrees C) of Supercritical
Carbon Dioxide from Polymeric Materials: PIF (0151z)**



**Figure . Desorption Diffusion (30 degrees C) of Supercritical
Carbon Dioxide from Polymeric Materials: PIF (0151z)**



**Figure . Fick's Law Plot of Desorption Diffusion (30 degrees C) of
Supercritical Carbon Dioxide from Polymeric Materials:
PIF (0151z)**



TGA Time, min	Temp., deg C	TGA Wt., mg	TGA Time, sec	Adjusted Time, sec	Adjusted Time, hr	SQRT Adj. Time, sec	Wt. Loss, %	Fractional Wt. Loss	Wt. @ Zero Time, mg	Wt. @ Zero Time, %	TGA Dry Wt., mg	Adjustment to TGA Time, sec	Hardness Scale
A	B	C	D	E	F	G	H	I	J	K	L	M	N
20.796	29.992	19.263	1247.760	1677.760	0.466	40.96	0.010	0.049	19.30	0.202	19.261	430	Shore D
62.516	30.002	19.237	3750.960	4180.960	1.161	64.66	-0.123	-0.608					
104.189	30.000	19.223	6251.340	6681.340	1.856	81.74	-0.198	-0.979					
145.869	30.001	19.212	8752.140	9182.140	2.551	95.82	-0.253	-1.249					
187.557	30.001	19.204	11253.420	11683.420	3.245	108.09	-0.297	-1.467					
229.275	30.003	19.196	13756.500	14186.500	3.941	119.11	-0.336	-1.659					
270.956	30.002	19.190	16257.360	16687.360	4.635	129.18	-0.369	-1.823					
312.682	30.000	19.184	18760.920	19190.920	5.331	138.53	-0.399	-1.969					
354.393	30.001	19.179	21263.580	21693.580	6.026	147.29	-0.425	-2.100					
396.099	30.002	19.174	23765.940	24195.940	6.721	155.55	-0.452	-2.231					
437.823	30.002	19.169	26269.380	26699.380	7.416	163.40	-0.477	-2.356					
479.574	30.003	19.165	28774.440	29204.440	8.112	170.89	-0.500	-2.472					
521.303	30.002	19.161	31278.180	31708.180	8.808	178.07	-0.522	-2.577					
563.065	30.002	19.157	33783.900	34213.900	9.504	184.97	-0.540	-2.669					
604.799	30.000	19.154	36287.940	36717.940	10.199	191.62	-0.558	-2.754					
646.496	30.002	19.151	38789.760	39219.760	10.894	198.04	-0.573	-2.831					
688.184	30.002	19.148	41291.040	41721.040	11.589	204.26	-0.588	-2.903					
729.891	30.002	19.145	43793.460	44223.460	12.284	210.29	-0.603	-2.979					
771.613	30.002	19.142	46296.780	46726.780	12.980	216.16	-0.618	-3.051					
813.384	30.002	19.140	48803.040	49233.040	13.676	221.89	-0.631	-3.115					
855.113	30.001	19.137	51306.780	51736.780	14.371	227.46	-0.644	-3.182					
896.833	30.001	19.135	53809.980	54239.980	15.067	232.89	-0.657	-3.244					
938.553	30.002	19.132	56313.180	56743.180	15.762	238.21	-0.668	-3.297					
980.277	30.001	19.130	58816.620	59246.620	16.457	243.41	-0.678	-3.349					
1022.013	30.002	19.128	61320.780	61750.780	17.153	248.50	-0.689	-3.403					
1063.747	30.000	19.126	63824.820	64254.820	17.849	253.49	-0.700	-3.459					
1105.466	30.001	19.124	66327.960	66757.960	18.544	258.38	-0.711	-3.513					
1147.171	30.000	19.122	68830.260	69260.260	19.239	263.17	-0.720	-3.556					
1188.895	30.000	19.121	71333.700	71763.700	19.934	267.89	-0.729	-3.600					
1230.615	30.000	19.119	73836.900	74266.900	20.630	272.52	-0.736	-3.633					
1272.314	30.000	19.118	76338.840	76768.840	21.325	277.07	-0.744	-3.674					
1314.042	30.005	19.117	78842.520	79272.520	22.020	281.55	-0.750	-3.705					
1355.781	30.002	19.115	81346.860	81776.860	22.716	285.97	-0.760	-3.751					
1397.511	30.002	19.113	83850.660	84280.660	23.411	290.31	-0.768	-3.792					
1461.253	30.001	19.111	87675.180	88105.180	24.474	296.83	-0.777	-3.838					
1680.891	30.002	19.106	100853.460	101283.460	28.134	318.25	-0.803	-3.967					
1930.898	30.002	19.102	115853.880	116283.880	32.301	341.00	-0.826	-4.077					
2180.899	30.002	19.099	130853.940	131283.940	36.468	362.33	-0.843	-4.162					
2430.897	30.002	19.095	145853.820	146283.820	40.634	382.47	-0.862	-4.259					
2680.898	30.002	19.091	160853.880	161283.880	44.801	401.60	-0.881	-4.349					

Formulae Used for Analysis of Data

Uppercase letters refer to columns

Lowercase n refers to row, beginning with n=4

Dn = (An * 60)

En = (Dn + M4)

Fn = (En / 3600)

Gn = SQRT (En)

Hn = ((Cn - L4) / L4) * 100)

In = ((Cn - L4) / (J4 - L4))

K4 = ((J4 - L4) / L4) * 100)

N16 = (((N12 - N8) / N8) * 100)

Source binary TA data file: pif0151z.01

14 lines in the parameter block

3 channels of data

Run 46

Module TGA Aluminum Pans

Sample PIF Polyimide Film 0151Z

Size 19.291 mg

Method DESORPTION-Isothermal

Operator bsi

Comment .336"x.012", HP15@1400 Dry: M-19.36 TGA-19.261 ET: 7:10

Nsig 3

Sig1 Time (min)

Sig2 Temperature (°C)

Sig3 Weight (mg)

Kcell 1.0000

Date 30-May-00

Time 11:18

Blank

FIGURE . CHEMICAL-MATERIAL INTERACTION DATA SET:
Supercritical Carbon Dioxide and Acrylonitrile-butadiene-styrene ABS

Sorption, Desorption Diffusion, and Indentation Data Sets

Material Data

Test Reference Number:	<u>05-1-1</u>	TGA Filename:	<u>abs0115d</u>
Property Test Specification:	ASTM D471/D543		
Material Name:	<u>Acrylonitrile-butadiene-styrene</u>	Material Code:	<u>ABS</u>
Material Supplier:	<u>Goodfellow</u>	Material Class:	<u>TP</u>
Monomer Source:	<u>Unknown</u>	Base Polymer (Lot. No.):	<u>Unknown</u>
Exposure Liquid:	<u>Supercritical Carbon Dioxide</u>	Replicate Number:	<u>1</u>

Pre-Exposure Data

Measured Diameter (mm):	<u>10.48</u>	<u>10.65</u>	<u>10.32</u>	<u>10.51</u>	
Mean Diameter:	<u>10.495</u>				
Measured Thickness (mils):	<u>65.60</u>	<u>62.00</u>	<u>61.40</u>	<u>59.70</u>	
Mean Thickness:	<u>62.175</u>				
Initial Sample Weight (mg):	<u>138.450</u>				
Initial Durometer Hardness:	<u>72.6</u>	Scale: SHORE	<u>D</u>		
				95% Confidence Level (CL):	<u>0.215</u>
				95% Confidence Level (CL):	<u>3.950</u>

Sample Exposure Data

Exposure Date:	<u>04/24/00</u>	Time:	<u>14:57:00</u>	
Removal Date:	<u>04/24/00</u>	Time:	<u>15:12:00</u>	
Total Exposure Time (h:m:s):	<u>00:15:00</u>	Weight of Sample After Exposure (mg):	<u>143.60</u>	
Weight Gain (mg):	<u>5.15</u>	Percent Weight Gain:	<u>3.72</u>	
Final Durometer Hardness After Desorption:	<u>73.4</u>	Percent Hardness Change:	<u>1.1</u>	

Desorption Experiment

Mean Temperature of Desorption Experiment (setpoint = 30 deg C):	<u>30.000</u>	95% CL:	<u>0.0009</u>
Time Lapse Between Sample Exposure and Sample Desorption (sec):			<u>495</u>
Equilibrium Weight of Desorbed Sample at 30 deg C (mg):			<u>138.410</u>
Sample Extracted (mg):	<u>0.04</u>	Solubility Corrected for Extractables (mg):	<u>5.19</u>
Sample Extracted (%):	<u>0.03</u>	Solubility Corrected for Extractables (%):	<u>3.75</u>

Diffusion Coefficient Data: Fick's Law

High Concentration Diffusion Coefficient (cm ² /sec):	<u>5.2834E-07</u>
Range Including 0,1 Intercept, Relative Weight Fraction:	<u>1.00 - 0.63</u>
Linear Range of Desorption, Relative Weight Fraction:	<u>0.77 - 0.63</u>
Slope: <u>-1.0387E-02</u>	X-axis Intercept: <u>9.6140E+01</u>
R Square: <u>0.99973</u>	Y-axis Intercept: <u>9.9862E-01</u>
Low Concentration Diffusion Coefficient (cm ² /sec):	<u>4.8703E-10</u>
Linear Range of Desorption, Relative Weight Fraction:	<u>0.05 - 0.00</u>
Slope: <u>-3.1536E-04</u>	X-axis Intercept: <u>3.9231E+02</u>
R Square: <u>0.97499</u>	Y-axis Intercept: <u>1.2372E-01</u>

Wt. @ Zero Time, mg K 143.60	Wt. @ Zero Time, % L 3.720	Adjustment to TGA Time, sec M 495	Hardness Shore Scale N D
TGA Dry Wt., mg 138.450	Equil. Wt. Of Desorb. Sample 138.41	Min. Wt. Used For FDC, mg. 138.410	Pre Exposure Hardness 72.6
High Conc. DC, cm2/sec 5.2834E-07	Low Conc. DC, cm2/sec 4.8703E-10	Total Liquid Sorbed, mg. 5.150	Post Desorption Hardness 73.4
R Square 0.99973	R Square 0.97499		Change in Hardness, % 1.1
X Intercept 96.14	X Intercept 392.3		Mean Thickness, cm. 0.1579
Y Intercept 0.99862	Y Intercept 0.12372		
Y Intercept as Wt., mg. 143.402	X Intercept as Time, hrs. 42.8	X Intercept as Time, min. 256.5	abs0115d X Intercept as Time, days 1.8

TEMPERATURE STATISTICS

<i>Column1</i>		Max. TGA Wt., (orig data file) 142.407	TGA Wt. At 20 min. Adjustment 141.729
Mean	30.00018454	Sorption @ 7-12 min., mg	Sorption @ 20 min., mg
Standard Error	0.000465527	3.96	3.28
Median	30		
Mode	29.999	Sorption @ 7-12	Sorption @ 20
Standard Deviation	0.026895999	min., %	min., %
Sample Variance	0.000723395	2.86	2.37
Kurtosis	453.545885		
Skewness	-12.8162299	Rel. Error (%) of	Rel. Error (%) of
Range	1.175	7-12 min. Sorp.	20 min. Sorp
Minimum	29.141	-23.2	-36.3
Maximum	30.316		
Sum	100140.616		
Count	3338		
Confidence Level(95.0%)	0.000912746		

DIAMETER STATISTICS

<i>Column1</i>	
Mean	10.49
Standard Error	0.06770032
Median	10.495
Mode	#N/A
Standard Deviation	0.13540064
Sample Variance	0.01833333
Kurtosis	1.28419835
Skewness	-0.2175362
Range	0.33
Minimum	10.32
Maximum	10.65
Sum	41.96
Count	4
Confidence Level(95.0%)	0.21545284

ND/value
ND/value
A/D

THICKNESS STATISTICS

<i>Column1</i>	
Mean	62.175
Standard Error	1.24121916
Median	61.7
Mode	#N/A
Standard Deviation	2.48243832
Sample Variance	6.1625
Kurtosis	1.90364577
Skewness	1.06966414
Range	5.9
Minimum	59.7
Maximum	65.6
Sum	248.7
Count	4
Confidence Level(95.0%)	3.95011703

Unknown
abs0115d

HIGH CONCENTRATION DIFFUSION COEFFICIENT

abs0115d

SUMMARY OUTPUT

<i>Regression Statistics</i>	
Multiple R	0.999866631
R Square	0.999733281
Adjusted R Square	0.999723022
Standard Error	0.001187972
Observations	28

ANOVA

	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	1	0.137535524	0.137535524	97454.6928	5.35851E-48
Residual	26	3.66932E-05	1.41128E-06		
Total	27	0.137572217			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>
Intercept	0.998619841	0.000977457	1021.651133	2.2026E-61	0.996610648	1.000629033
X Variable 1	-0.010387099	3.32731E-05	-312.1773418	5.3585E-48	-0.010455493	-0.010318705

LOW CONCENTRATION DIFFUSION COEFFICIENT

SUMMARY OUTPUT

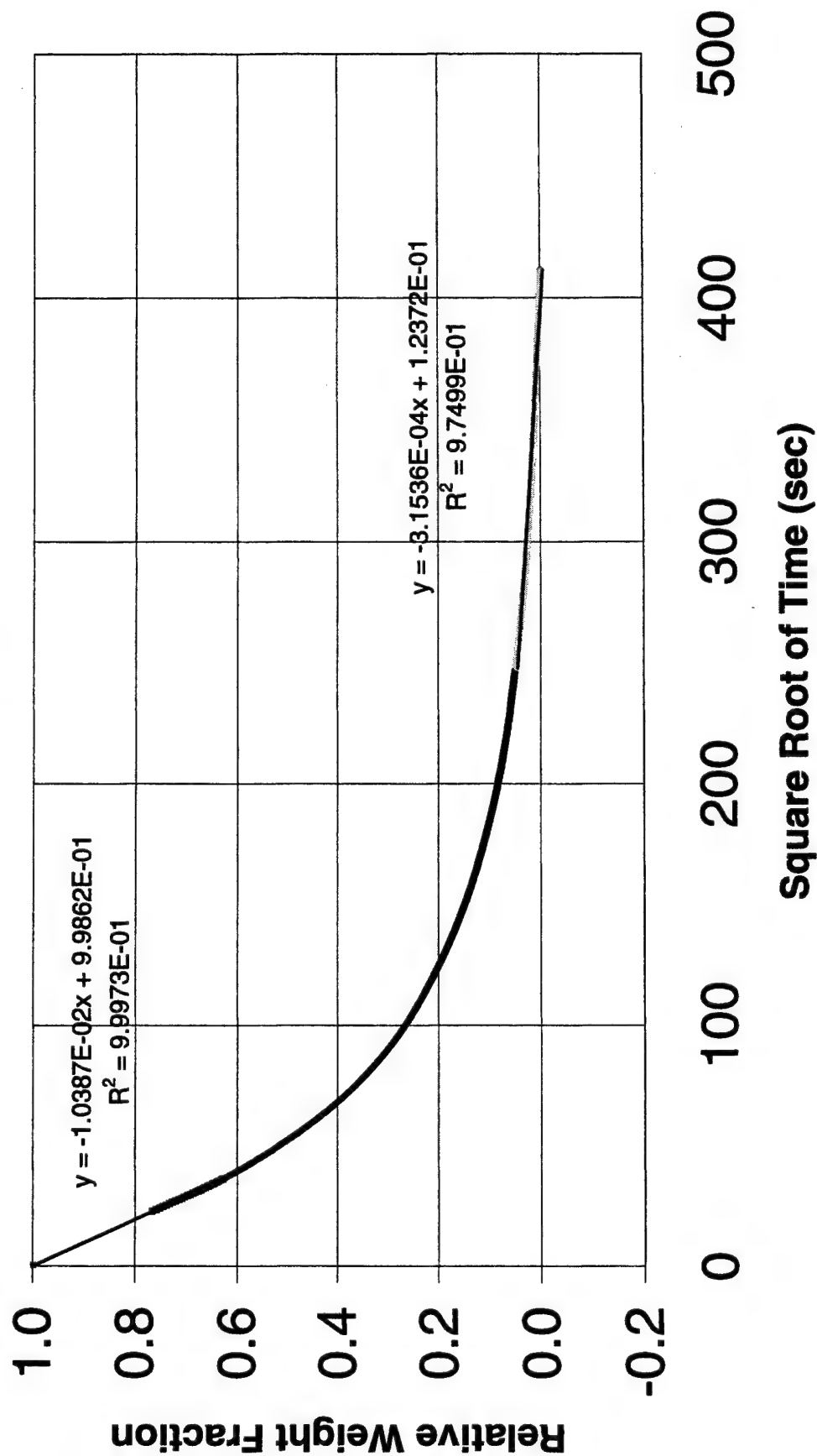
<i>Regression Statistics</i>	
Multiple R	0.987415446
R Square	0.974989262
Adjusted R Square	0.974970315
Standard Error	0.002339443
Observations	1322

ANOVA

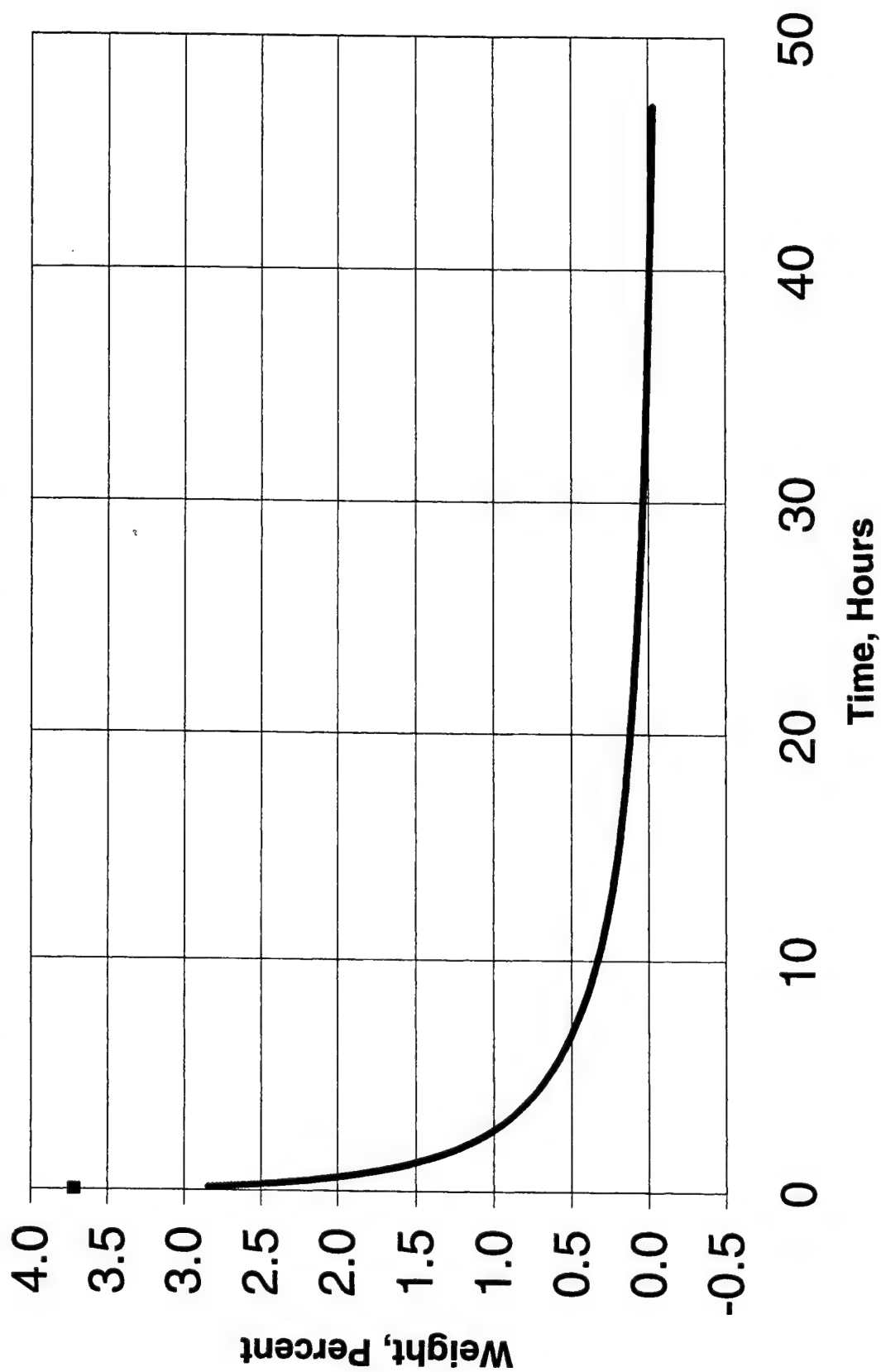
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	1	0.281625661	0.281625661	51457.3321	0
Residual	1320	0.007224352	5.47299E-06		
Total	1321	0.288850013			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>
Intercept	0.123720738	0.000423464	292.1633424	0	0.122890002	0.124551474
X Variable 1	-0.000315365	1.39024E-06	-226.8420863	0	-0.000318092	-0.000312638

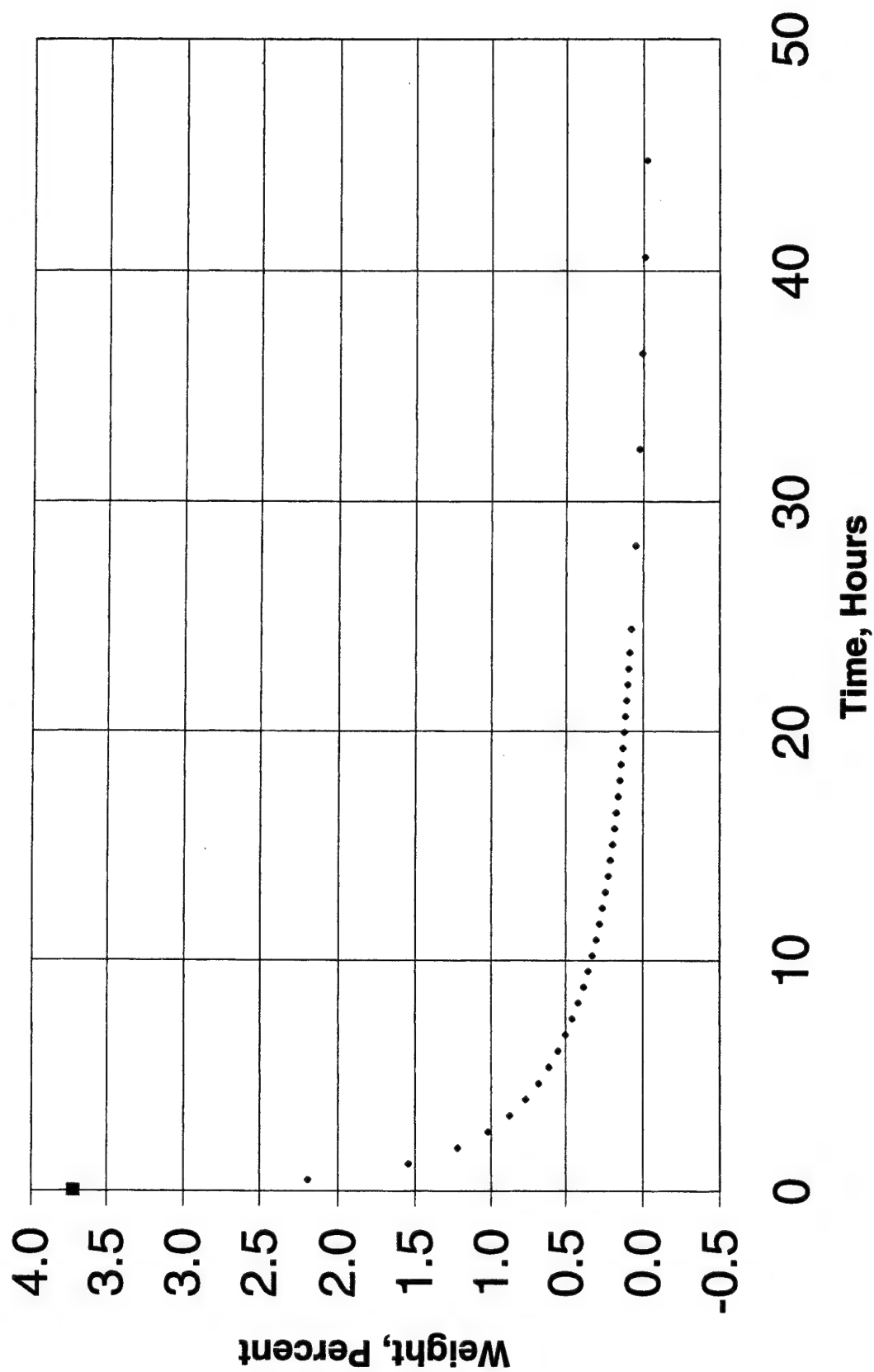
**Figure . Fick's Law Plot of Desorption Diffusion (30 degrees C)
of Supercritical Carbon Dioxide from Polymeric Materials:
ABS (0115d)**



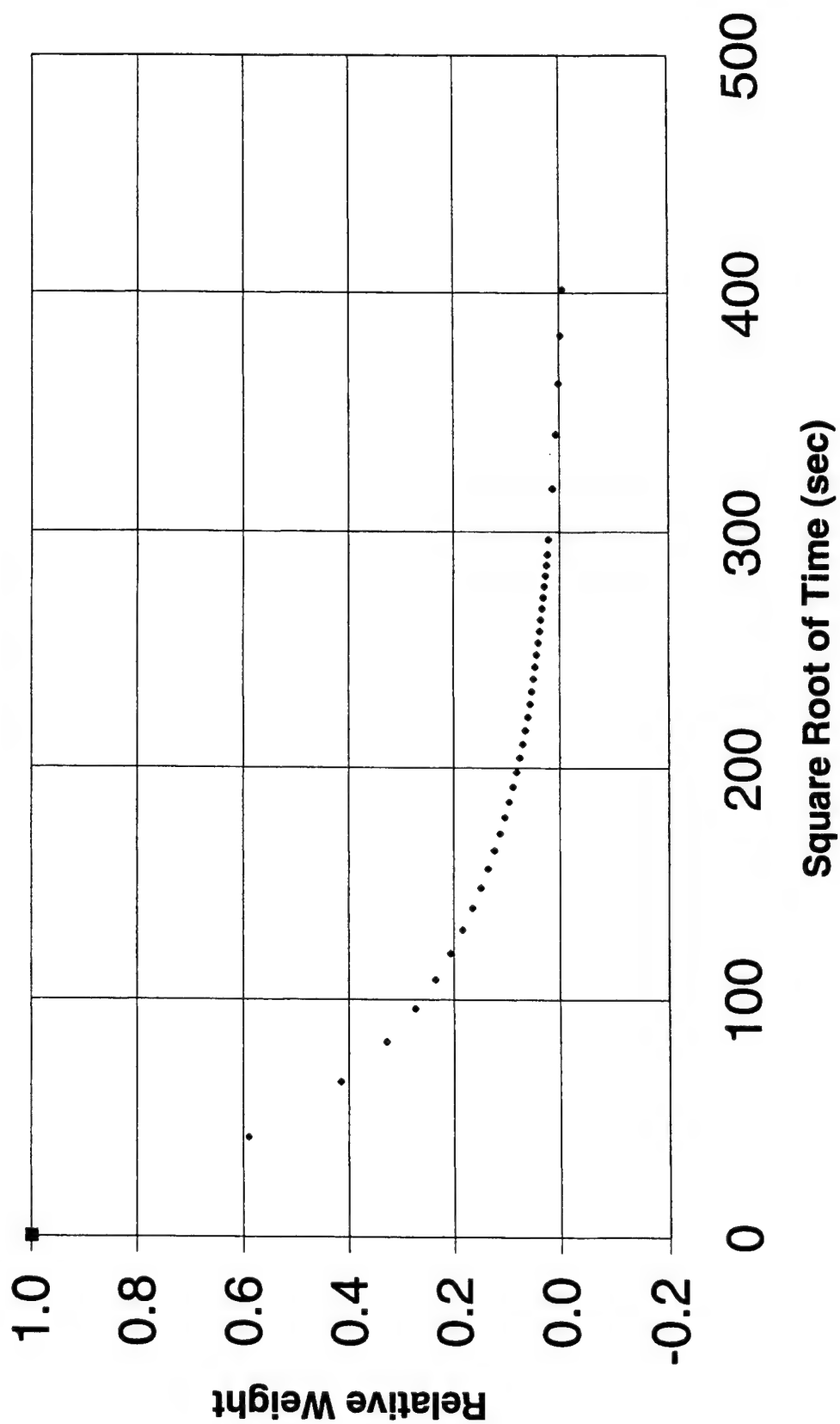
**Figure . Desorption Diffusion (30 degrees C) of Supercritical
Carbon Dioxide from Polymeric Materials: ABS (0115d)**



**Figure . Desorption Diffusion (30 degrees C) of Supercritical
Carbon Dioxide from Polymeric Materials: ABS (0115d)**



**Figure . Fick's Law Plot of Desorption Diffusion (30 degrees C) of
Supercritical Carbon Dioxide from Polymeric Materials:
ABS (0115d)**



TGA Time, min	Temp., deg C	TGA Wt., mg	TGA Time, sec	Adjusted Time, sec	Adjusted Time, hr	SQRT Adj. Time, sec	Wt. Loss, %	Fractional Wt. Loss	Wt. @ Zero Time, mg	Wt. @ Zero Time, %	TGA Dry Wt., mg	Adjustment to TGA Time, sec	Hardness Scale
A	B	C	D	E	F	G	H	I	J	K	L	M	N
20.750	30.001	141.484	1245.000	1740.000	0.483	41.71	2.194	0.589	143.60	3.722	138.447	495	Shore D
62.426	30.001	140.584	3745.560	4240.560	1.178	65.12	1.544	0.415					
104.127	30.000	140.141	6247.620	6742.620	1.873	82.11	1.224	0.329					
145.815	30.001	139.861	8748.900	9243.900	2.568	96.15	1.021	0.274					
187.520	30.000	139.862	11251.200	11746.200	3.263	108.38	0.878	0.236					
229.212	30.000	139.512	13752.720	14247.720	3.958	119.36	0.769	0.207					
270.917	30.000	139.392	16255.020	16750.020	4.653	129.42	0.683	0.183					
312.612	30.000	139.294	18756.720	19251.720	5.348	138.75	0.612	0.164					
354.315	30.000	139.212	21258.900	21753.900	6.043	147.49	0.553	0.148					
396.074	30.000	139.141	23764.440	24259.440	6.739	155.75	0.501	0.135					
437.818	30.000	139.080	26269.080	26764.080	7.434	163.60	0.457	0.123					
479.576	30.000	139.025	28774.560	29269.560	8.130	171.08	0.417	0.112					
521.268	30.000	138.978	31276.080	31771.080	8.825	178.24	0.384	0.103					
562.958	30.000	138.936	33777.480	34272.480	9.520	185.13	0.353	0.095					
604.640	30.000	138.898	36278.400	36773.400	10.215	191.76	0.326	0.088					
646.338	30.000	138.864	38780.280	39275.280	10.910	198.18	0.301	0.081					
688.037	30.000	138.834	41282.220	41777.220	11.605	204.39	0.280	0.075					
729.746	30.000	138.806	43784.760	44279.760	12.300	210.43	0.259	0.070					
771.465	30.000	138.781	46287.900	46782.900	12.995	216.29	0.241	0.065					
813.211	30.000	138.758	48792.660	49287.660	13.691	222.01	0.225	0.060					
854.983	30.000	138.737	51292.980	51787.980	14.386	227.57	0.209	0.056					
896.590	30.000	138.718	53795.400	54290.400	15.081	233.00	0.196	0.053					
938.299	30.000	138.701	56297.940	56792.940	15.776	238.31	0.183	0.049					
980.034	30.000	138.684	58802.040	59297.040	16.471	243.51	0.171	0.046					
1021.738	30.000	138.668	61304.280	61799.280	17.166	248.59	0.160	0.043					
1063.459	30.001	138.653	63807.540	64302.540	17.862	253.58	0.149	0.040					
1105.162	30.000	138.641	66309.720	66804.720	18.557	258.47	0.140	0.038					
1146.880	30.000	138.628	68812.800	69307.800	19.252	263.26	0.131	0.035					
1188.571	30.000	138.615	71314.260	71809.260	19.947	267.97	0.121	0.033					
1230.279	30.000	138.604	73816.740	74311.740	20.642	272.60	0.113	0.030					
1272.036	30.000	138.594	76322.160	76817.160	21.338	277.16	0.106	0.029					
1313.766	30.000	138.584	78825.960	79320.960	22.034	281.64	0.099	0.027					
1355.487	30.000	138.574	81329.220	81824.220	22.729	286.05	0.092	0.025					
1397.192	30.000	138.565	83831.520	84326.520	23.424	290.39	0.085	0.023					
1459.073	30.000	138.553	87544.380	88039.380	24.155	296.71	0.077	0.021					
1676.427	30.000	138.515	100565.620	101080.620	28.078	317.93	0.049	0.013					
1926.431	30.000	138.482	115585.860	116080.860	32.245	340.71	0.025	0.007					
2176.436	30.000	138.456	130586.160	131081.160	36.411	362.05	0.007	0.002					
2426.437	30.000	138.434	145586.220	146081.220	40.578	382.21	-0.009	-0.003					
2676.438	30.000	138.415	160586.280	161081.280	44.745	401.35	-0.023	-0.006					

Formulae Used for Analysis of Data

Uppercase letters refer to columns

Lowercase n refers to row, beginning with n=4

Dn = (An * 60)

En = (Dn + M4)

Fn = (En / 3600)

Gn = SQRT (En)

Hn = (((Cn - L4) / L4) * 100)

In = (((J4 - L4) / (J4 - L4))

K4 = (((J4 - L4) / L4) * 100)

N16 = (((N12 - N8) / N8) * 100)

Source binary TA data file : abs0115d.01

14 lines in the parameter block

3 channels of data

Run 32

Module TGA Aluminum Pans

Sample ABS SCCO2 0115D

Size 142.407 mg

Method DESORPTION-Isothermal

Operator BSI

Comment Disk: 4x0.06in., HP@1400x50, Dry: TG-138.447 M-138.58 ET: 8:15

Nsig 3

Sig1 Time (min)

Sig2 Temperature (°C)

Sig3 Weight (mg)

Kcell 1.0000

Date 24-Apr-00

Time 15:21

Blank

FIGURE . CHEMICAL-MATERIAL INTERACTION DATA SET:**Supercritical Carbon Dioxide and Polyurethane****PU****Sorption, Desorption Diffusion, and Indentation Data Sets****Material Data**

Test Reference Number:	<u>06-1-1</u>	TGA Filename:	<u>pu0124d</u>
Property Test Specification:	ASTM D471/D543		
Material Name:	<u>Polyurethane</u>	Material Code:	<u>PU</u>
Material Supplier:	<u>Unknown</u>	Material Class:	<u>U</u>
Monomer Source:	<u>Unknown</u>	Base Polymer (Lot. No.):	<u>Unknown</u>
Exposure Liquid:	<u>Supercritical Carbon Dioxide</u>	Replicate Number:	<u>1</u>

Pre-Exposure Data

Measured Diameter (mm):	<u>9.82</u>	<u>9.68</u>	<u>9.84</u>	<u>9.63</u>	
Mean Diameter:	<u>9.750</u>				
Measured Thickness (mils):	<u>42.20</u>	<u>42.10</u>	<u>42.00</u>	<u>42.10</u>	
Mean Thickness:	<u>42.100</u>				
Initial Sample Weight (mg):	<u>132.580</u>				
Initial Durometer Hardness:	<u>96.9</u>	Scale: SHORE	<u>A</u>		

Sample Exposure Data

Exposure Date:	<u>05/03/00</u>	Time:	<u>10:26:00</u>	
Removal Date:	<u>05/03/00</u>	Time:	<u>10:41:00</u>	
Total Exposure Time (h:m:s):	<u>00:15:00</u>	Weight of Sample After Exposure (mg):	<u>141.60</u>	
Weight Gain (mg):	<u>9.02</u>	Percent Weight Gain:	<u>6.80</u>	
Final Durometer Hardness After Desorption:	<u>97.0</u>	Percent Hardness Change:	<u>0.1</u>	

Desorption Experiment

Mean Temperature of Desorption Experiment (setpoint = 30 deg C):	<u>30.000</u>	95% CL:	<u>0.0009</u>
Time Lapse Between Sample Exposure and Sample Desorption (sec):			<u>555</u>
Equilibrium Weight of Desorbed Sample at 30 deg C (mg):			<u>132.210</u>
Sample Extracted (mg):	<u>0.37</u>	Solubility Corrected for Extractables (mg):	<u>9.39</u>
Sample Extracted (%):	<u>0.28</u>	Solubility Corrected for Extractables (%):	<u>7.08</u>

Diffusion Coefficient Data: Fick's Law

High Concentration Diffusion Coefficient (cm ² /sec):	<u>2.5629E-07</u>
Range Including 0,1 Intercept, Relative Weight Fraction:	<u>1.00 - 0.62</u>
Linear Range of Desorption, Relative Weight Fraction:	<u>0.75 - 0.62</u>
Slope:	<u>-1.0684E-02</u>
X-axis Intercept:	<u>9.3874E+01</u>
R Square:	<u>0.99971</u>
Y-axis Intercept:	<u>1.0030E+00</u>

Low Concentration Diffusion Coefficient (cm ² /sec):	<u>7.5549E-11</u>
Linear Range of Desorption, Relative Weight Fraction:	<u>0.03 - 0.00</u>
Slope:	<u>-1.8344E-04</u>
X-axis Intercept:	<u>2.7272E+02</u>
R Square:	<u>0.80890</u>
Y-axis Intercept:	<u>5.0026E-02</u>

Wt. @ Zero Time, mg K 141.60	Wt. @ Zero Time, % L 6.803	Adjustment to TGA Time, sec M 555	Hardness Shore Scale N A
TGA Dry Wt., mg 132.580	Equil. Wt. Of Desorb. Sample 132.21	Min. Wt. Used For FDC, mg. 132.210	Pre Exposure Hardness 96.9
High Conc. DC, cm2/sec 2.5629E-07	Low Conc. DC, cm2/sec 7.5549E-11	Total Liquid Sorbed, mg. 9.020	Post Desorption Hardness 97.0
R Square 0.99971	R Square 0.80890		Change in Hardness, % 0.1
X Intercept 93.87	X Intercept 272.7		Mean Thickness, cm. 0.1069
Y Intercept 1.00296	Y Intercept 0.05003		
Y Intercept as Wt., mg. 142.019	X Intercept as Time, hrs. 20.7	X Intercept as Time, min. 124.0	pu0124d X Intercept as Time, days 0.9

TEMPERATURE STATISTICS

<i>Column1</i>		Max. TGA Wt., (orig data file) 139.304	TGA Wt. At 20 min. Adjustment 138.139
Mean	30.00004864	Sorption @ 7-12 min., mg	Sorption @ 20 min., mg
Standard Error	0.000470253	6.72	5.56
Median	30		
Mode	30.002	Sorption @ 7-12	Sorption @ 20
Standard Deviation	0.025319519	min., %	min., %
Sample Variance	0.000641078	5.07	4.19
Kurtosis	483.2349079		
Skewness	-15.26590206	Rel. Error (%) of	Rel. Error (%) of
Range	1.06	7-12 min. Sorp.	20 min. Sorp
Minimum	29.197	-25.5	-38.4
Maximum	30.257		
Sum	86970.141		
Count	2899		
Confidence Level(95.0%)	0.000922064		

HIGH CONCENTRATION DIFFUSION COEFFICIENT

pu0124d

SUMMARY OUTPUT

<i>Regression Statistics</i>	
Multiple R	0.999852658
R Square	0.999705338
Adjusted R Square	0.99969306
Standard Error	0.001298315
Observations	26

ANOVA

	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	1	0.137252202	0.137252202	81425.24	6.90655E-44
Residual	24	4.04549E-05	1.68562E-06		
Total	25	0.137292657			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>
Intercept	1.002957462	0.001116626	898.2035895	7.7393E-56	1.00065286	1.005262064
X Variable 1	-0.010684114	3.7442E-05	-285.3510819	6.9066E-44	-0.01076139	-0.010606837

LOW CONCENTRATION DIFFUSION COEFFICIENT

SUMMARY OUTPUT

<i>Regression Statistics</i>	
Multiple R	0.8993903
R Square	0.808902912
Adjusted R Square	0.808806203
Standard Error	0.003258879
Observations	1978

ANOVA

	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	1	0.088831255	0.088831255	8364.29361	0
Residual	1976	0.0209857	1.06203E-05		
Total	1977	0.109816955			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>
Intercept	0.050025635	0.000482698	103.637583	0	0.049078985	0.050972286
X Variable 1	-0.000183435	2.00571E-06	-91.4565121	0	-0.000187369	-0.000179502

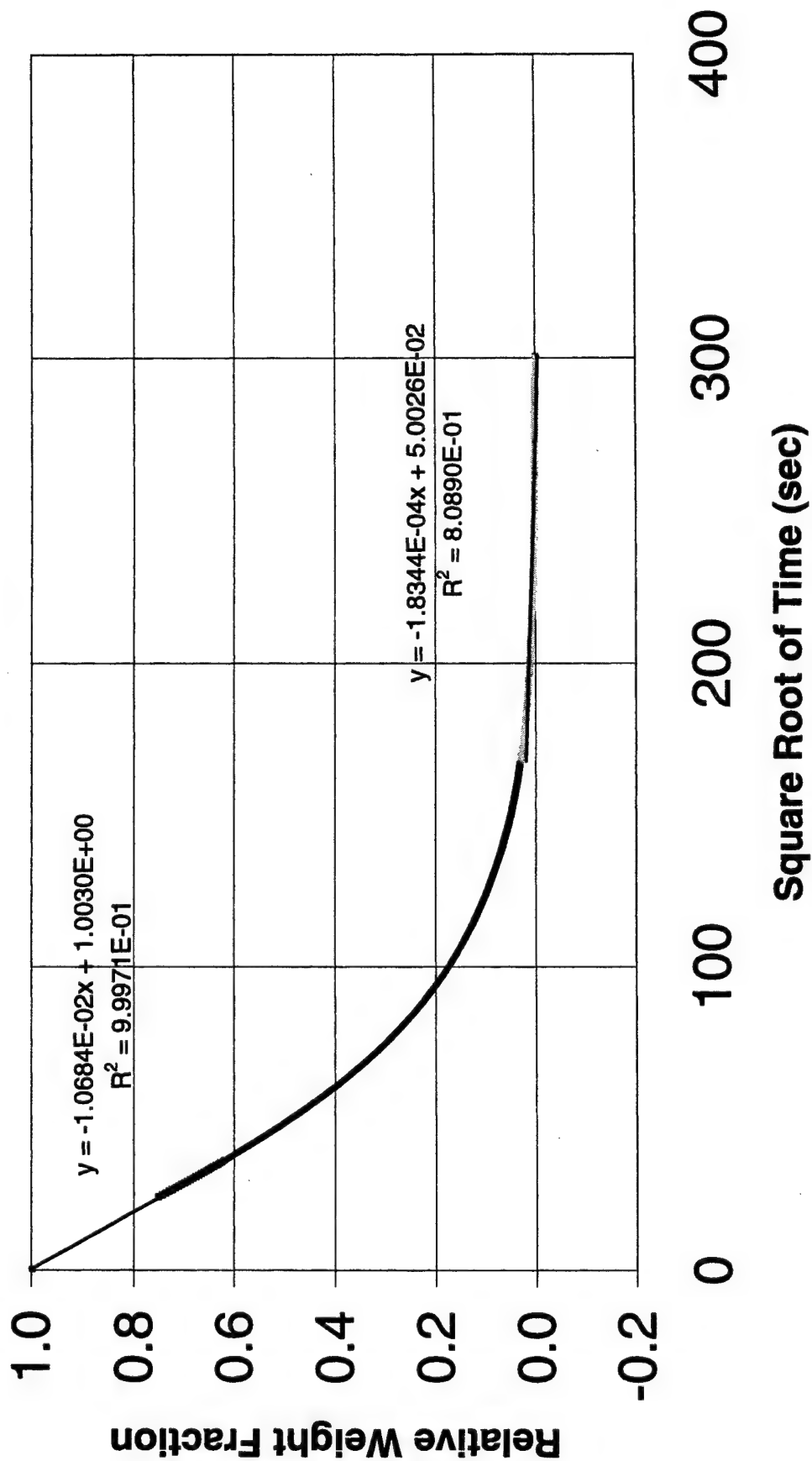
DIAMETER STATISTICS

<i>Column1</i>	
Mean	9.7425
Standard Error	0.05170026
Median	9.75
Mode	#N/A
Standard Deviation	0.10340052
Sample Variance	0.01069167
Kurtosis	-4.6970753
Skewness	-0.1662108
Range	0.21
Minimum	9.63
Maximum	9.84
Sum	38.97
Count	4
Confidence Level(95.0%)	0.16453345

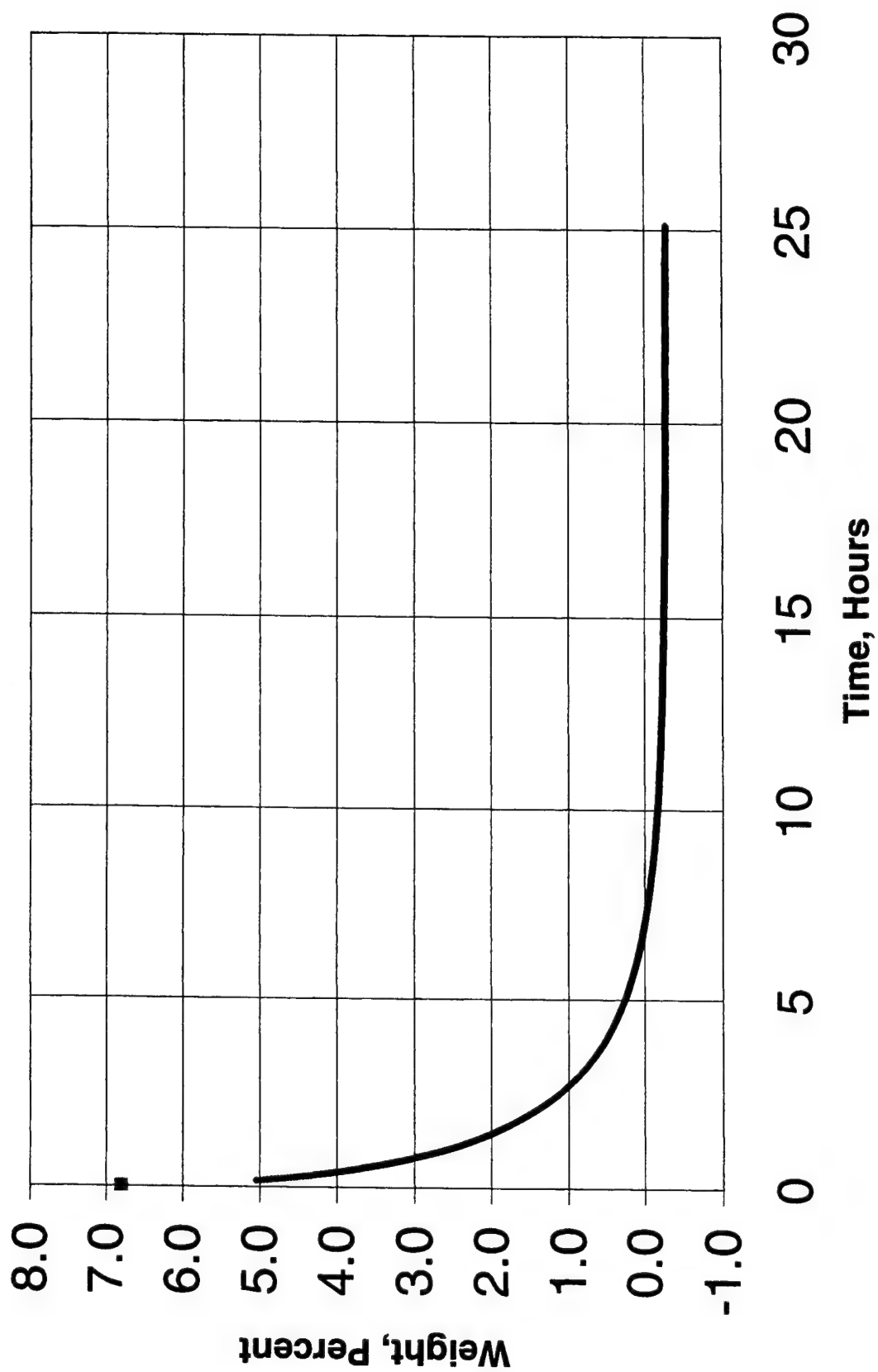
THICKNESS STATISTICS

<i>Column1</i>	
Mean	42.1
Standard Error	0.04082483
Median	42.1
Mode	42.1
Standard Deviation	0.08164966
Sample Variance	0.00666667
Kurtosis	1.5
Skewness	0
Range	0.2
Minimum	42
Maximum	42.2
Sum	168.4
Count	4
Confidence Level(95.0%)	0.12992295

**Figure . Fick's Law Plot of Desorption Diffusion (30 degrees C)
of Supercritical Carbon Dioxide from Polymeric Materials:
PU (0124d)**



**Figure . Desorption Diffusion (30 degrees C) of Supercritical
Carbon Dioxide from Polymeric Materials: PU (0124d)**



**Figure . Desorption Diffusion (30 degrees C) of Supercritical
Carbon Dioxide from Polymeric Materials: PU (0124d)**

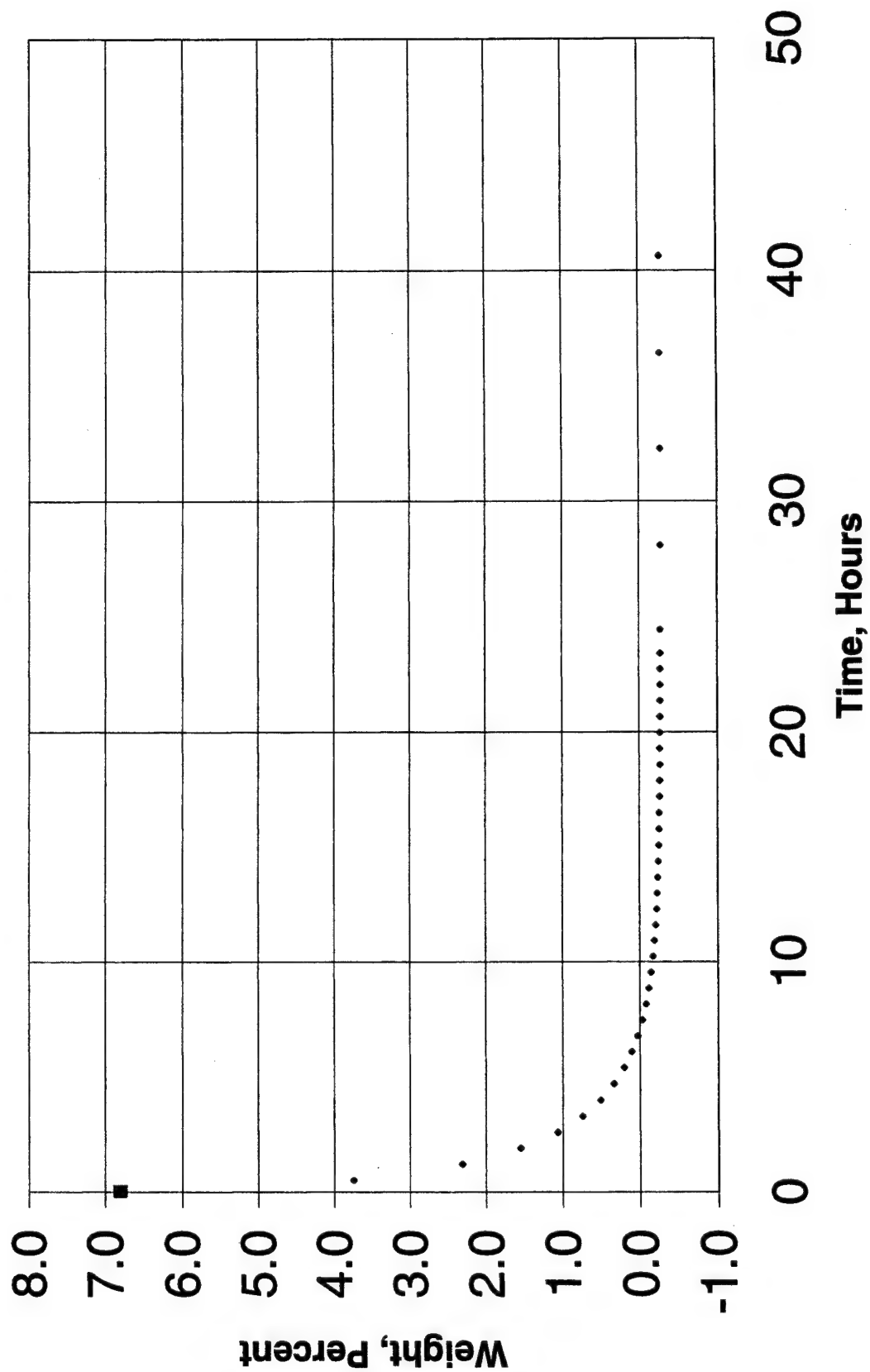
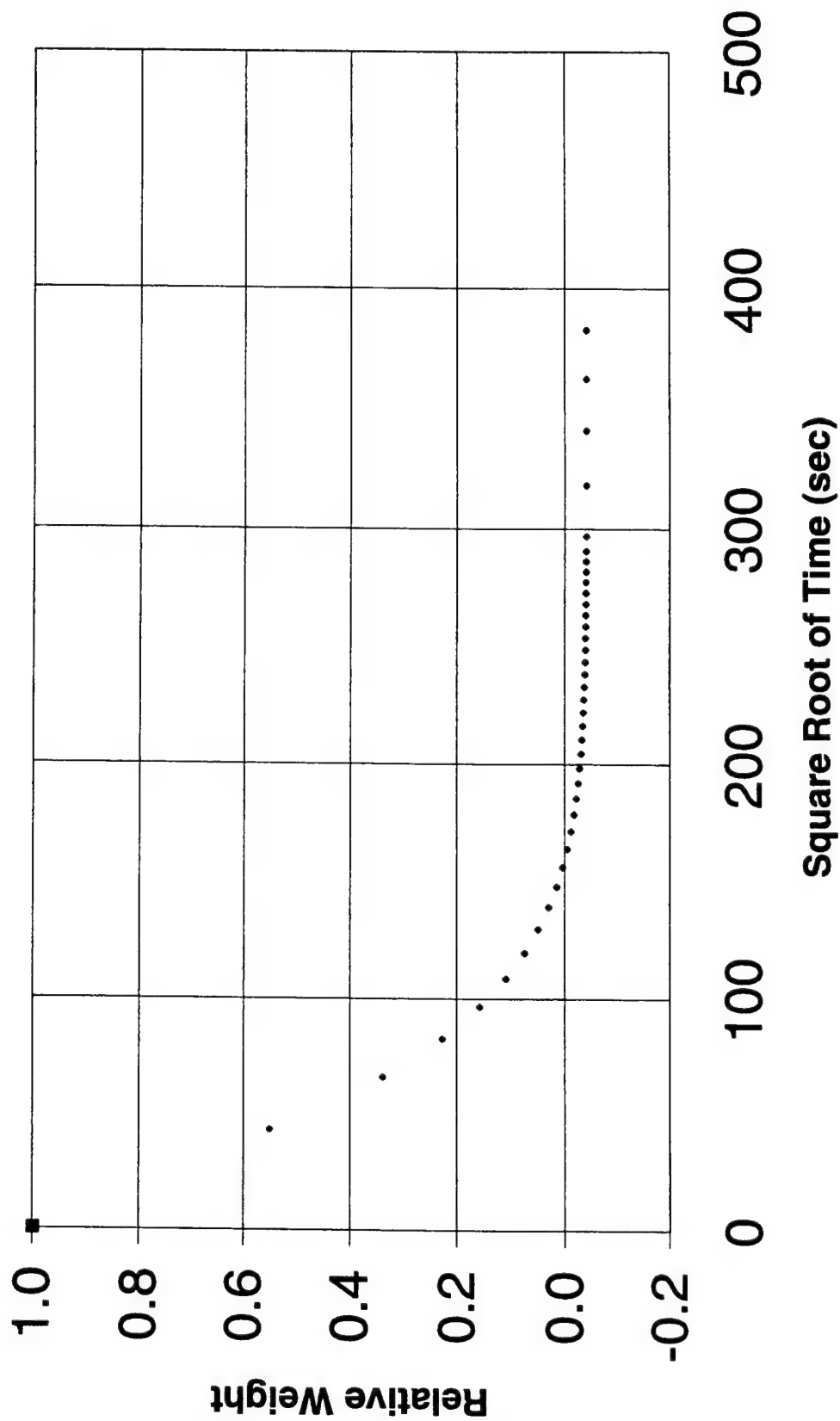


Figure . Fick's Law Plot of Desorption Diffusion (30 degrees C) of Supercritical Carbon Dioxide from Polymeric Materials: PU (0124d)



TGA Time, min A	Temp., deg C B	TGA Wt., mg C	TGA Time, sec D	Adjusted Time, sec E	Adjusted Time, hr F	SQRT Adj. Time, sec G	Wt. Loss, % H	Fractional Wt. Loss I	Wt. Zero Time, mg J	Wt. Zero Time, % K	TGA Dry Wt., mg L	Adjustment to TGA Time, sec M	Hardness Scale N
20.767	29.997	137.544	1246.020	1801.020	0.500	42.44	3.748	0.551	141.60	6.807	132.575	555	Shore A
62.462	30.000	135.639	3747.720	4302.720	1.195	65.60	2.311	0.340					
104.169	30.000	134.631	6250.140	6805.140	1.890	82.49	1.551	0.228					
145.852	30.000	133.993	8751.120	9306.120	2.585	96.47	1.070	0.157					
187.552	30.000	133.558	11253.120	11808.120	3.280	108.67	0.741	0.109					
229.244	30.000	133.248	13754.640	14309.640	3.975	119.62	0.508	0.075					
270.933	30.000	133.020	16255.980	16810.980	4.670	129.68	0.336	0.049					
312.649	30.000	132.847	18758.940	19313.940	5.365	138.97	0.205	0.030					
354.341	30.000	132.714	21260.460	21815.460	6.060	147.70	0.105	0.015					
396.060	30.000	132.612	23763.600	24318.600	6.755	155.94	0.028	0.004					
437.751	30.000	132.534	26265.060	26820.060	7.450	163.77	-0.031	-0.005					
479.481	30.000	132.472	28768.860	29323.860	8.146	171.24	-0.078	-0.011					
521.185	30.000	132.423	31271.100	31826.100	8.841	178.40	-0.115	-0.017					
562.924	30.000	132.382	33775.440	34330.440	9.536	185.28	-0.146	-0.021					
604.616	30.001	132.351	36276.960	36831.960	10.231	191.92	-0.169	-0.025					
646.286	30.000	132.326	38777.160	39332.160	10.926	198.32	-0.188	-0.028					
687.966	30.000	132.305	41277.960	41832.960	11.620	204.53	-0.204	-0.030					
729.669	30.000	132.288	43780.140	44335.140	12.315	210.56	-0.216	-0.032					
771.375	30.000	132.275	46282.500	46837.500	13.010	216.42	-0.226	-0.033					
813.131	30.000	132.264	48787.860	49342.860	13.706	222.13	-0.235	-0.034					
854.838	30.000	132.256	51290.280	51845.280	14.401	227.70	-0.241	-0.035					
896.567	30.000	132.247	53794.020	54349.020	15.097	233.13	-0.247	-0.036					
938.305	30.001	132.240	56298.300	56853.300	15.793	238.44	-0.253	-0.037					
980.016	30.000	132.235	58800.960	59355.960	16.488	243.63	-0.256	-0.038					
1021.711	30.000	132.230	61302.660	61857.660	17.183	248.71	-0.260	-0.038					
1063.432	30.000	132.227	63805.920	64360.920	17.878	253.69	-0.262	-0.039					
1105.143	30.000	132.224	66308.580	66863.580	18.573	258.58	-0.265	-0.039					
1146.859	30.000	132.222	68811.540	69366.540	19.268	263.38	-0.266	-0.039					
1188.582	30.000	132.221	71314.920	71869.920	19.964	268.09	-0.267	-0.039					
1230.274	30.000	132.219	73816.440	74371.440	20.659	272.71	-0.269	-0.039					
1272.005	30.000	132.217	76320.300	76875.300	21.354	277.26	-0.270	-0.040					
1313.726	30.000	132.216	78823.560	79378.560	22.050	281.74	-0.271	-0.040					
1355.488	30.000	132.215	81329.280	81884.280	22.746	286.15	-0.272	-0.040					
1397.207	30.000	132.214	83832.420	84387.420	23.441	290.50	-0.272	-0.040					
1459.451	30.000	132.212	87567.060	88122.060	24.137	294.85	-0.274	-0.040					
1677.250	30.000	132.210	100635.000	101190.000	28.108	318.10	-0.275	-0.040					
1927.272	30.000	132.210	115636.320	116191.320	32.275	340.87	-0.275	-0.040					
2177.279	30.000	132.210	130636.740	131191.740	36.442	362.20	-0.275	-0.040					
2427.284	30.000	132.211	145637.040	146192.040	40.609	382.35	-0.275	-0.040					

Formulae Used for Analysis of Data
 Uppercase letters refer to columns
 Lowercase n refers to row, beginning with n=4

 $Dn = (An * 60)$
 $En = (Dn + M4)$
 $Fn = (En / 3600)$
 $Gn = SQRT (En)$
 $Hn = (((Cn - L4) / L4) * 100)$
 $In = (((Cn - L4) / (J4 - L4))$
 $K4 = (((J4 - L4) / L4) * 100)$
 $N16 = (((N12 - N8) / N8) * 100)$

Source binary TA data file : pu0124d.01
 14 lines in the parameter block
 3 channels of data

 Run 34
 Module TGA Aluminum Pans
 Sample PU SCCO2 124D
 Size 139.304 mg
 Method DESORPTION-Isothermal
 Operator WJS
 Comment Disk: .382x.0668IN, HP 1400x50, Dry: TG-132.575 M-132.81 ET:9:15
 Nsig 3
 Sig1 Time (min)
 Sig2 Temperature (°C)
 Sig3 Weight (mg)
 Koell 1.0000
 Date 3-May-00
 Time 10:51

Blank

FIGURE 1. CHEMICAL-MATERIAL INTERACTION DATA SET:
Supercritical Carbon Dioxide and Silicone Modified Organic SMO

Supercritical Carbon Dioxide and Silicone Modified Organic

SMO

Sorption, Desorption Diffusion, and Indentation Data Sets

Material Data

Test Reference Number:	<u>07-1-1</u>	TGA Filename:	<u>smo0129d</u>
Property Test Specification:	ASTM D471/D543		
Material Name:	<u>Silicone Modified Organic</u>	Material Code:	<u>SMO</u>
Material Supplier:	<u>Unknown</u>	Material Class:	<u>Q</u>
Monomer Source:	<u>Unknown</u>	Base Polymer (Lot. No.):	<u>Unknown</u>
Exposure Liquid:	<u>Supercritical Carbon Dioxide</u>	Replicate Number:	<u>1</u>

Pre-Exposure Data

Measured Diameter (mm):	<u>9.83</u>	<u>9.91</u>	<u>9.90</u>	<u>9.80</u>	
Mean Diameter:	<u>9.865</u>				95% Confidence Level (CL): <u>0.085</u>
Measured Thickness (mils):	<u>75.00</u>	<u>74.90</u>	<u>75.00</u>	<u>75.10</u>	
Mean Thickness:	<u>75.000</u>				95% Confidence Level (CL): <u>0.130</u>
Initial Sample Weight (mg):	<u>148.460</u>				
Initial Durometer Hardness:	58.6	Scale: SHORE		A	

Sample Exposure Data

Exposure Date:	<u>05/08/00</u>	Time:	<u>14:25:00</u>
Removal Date:	<u>05/08/00</u>	Time:	<u>14:40:00</u>
Total Exposure Time (h:m:s):	<u>00:15:00</u>	Weight of Sample After Exposure (mg):	<u>155.80</u>
Weight Gain (mg):	<u>7.34</u>	Percent Weight Gain:	<u>4.94</u>
Final Durometer Hardness After Desorption:	58.9	Percent Hardness Change:	0.5

Desorption Experiment

Mean Temperature of Desorption Experiment (setpoint = 30 deg C):	<u>30.000</u>	95% CL:	<u>0.0013</u>
Time Lapse Between Sample Exposure and Sample Desorption (sec):			<u>615</u>
Equilibrium Weight of Desorbed Sample at 30 deg C (mg):			<u>148.750</u>
Sample Extracted (mg):	<u>-0.29</u>	Solubility Corrected for Extractables (mg):	<u>7.34</u>
Sample Extracted (%):	<u>-0.20</u>	Solubility Corrected for Extractables (%):	<u>4.94</u>

Diffusion Coefficient Data: Fick's Law

High Concentration Diffusion Coefficient (cm ² /sec):	5.1028E-07
Range Including 0,1 Intercept, Relative Weight Fraction:	1.00 - 0.66
Linear Range of Desorption, Relative Weight Fraction:	0.79 - 0.66
Slope: -8.4624E-03	X-axis Intercept: 1.1827E+02
R Square: 0.99995	Y-axis Intercept: 1.0008E+00

Low Concentration Diffusion Coefficient (cm2/sec):	<u>2.8522E-09</u>
Linear Range of Desorption, Relative Weight Fraction:	<u>0.07 - 0.04</u>
Slope: <u>-6.3267E-04</u>	X-axis Intercept: <u>3.3044E+02</u>
R Square: <u>0.99463</u>	Y-axis Intercept: <u>2.0906E-01</u>

Wt. @ Zero Time, mg K 155.80	Wt. @ Zero Time, % L 4.944	Adjustment to TGA Time, sec M 615	Hardness Shore Scale N A
TGA Dry Wt., mg 148.460	Equil. Wt. Of Desorb. Sample 148.75	Min. Wt. Used For FDC, mg. 148.460	Pre Exposure Hardness 58.6
High Conc. DC, cm2/sec 5.1028E-07	Low Conc. DC, cm2/sec 2.8522E-09	Total Liquid Sorbed, mg. 7.340	Post Desorption Hardness 58.9
R Square 0.99995	R Square 0.99463		Change in Hardness, % 0.5
X Intercept 118.27	X Intercept 330.4		Mean Thickness, cm. 0.1905
Y Intercept 1.00083	Y Intercept 0.20906		
Y Intercept as Wt., mg. 155.930	X Intercept as Time, hrs. 30.3	X Intercept as Time, min. 182.0	smo0129d X Intercept as Time, days 1.3

TEMPERATURE STATISTICS

<i>Column1</i>		Max. TGA Wt., (orig data file) 154.274	TGA Wt. At 20 min. Adjustment 153.654
Mean	30.00005822	Sorption @ 7-12 min., mg	Sorption @ 20 min., mg
Standard Error	0.000677744	5.81	5.19
Median	30		
Mode	30	Sorption @ 7-12	Sorption @ 20
Standard Deviation	0.033354348	min., %	min., %
Sample Variance	0.001112513	3.92	3.50
Kurtosis	358.3810313		
Skewness	-12.57316686	Rel. Error (%) of	Rel. Error (%) of
Range	1.248	7-12 min. Sorp.	20 min. Sorp
Minimum	29.076	-20.8	-29.2
Maximum	30.324		
Sum	72660.141		
Count	2422		
Confidence Level(95.0%)	0.001329017		

HIGH CONCENTRATION DIFFUSION COEFFICIENT

smo0129d

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.999975055
R Square	0.99995011
Adjusted R Square	0.999948643
Standard Error	0.000437112
Observations	36

ANOVA

	df	SS	MS	F	Significance F
Regression	1	0.13020571	0.13020571	681465.356	9.98267E-75
Residual	34	6.49629E-06	1.91067E-07		
Total	35	0.130212206			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	1.00083354	0.000340523	2939.109506	1.7733E-93	1.000141515	1.001525565
X Variable 1	-0.008462427	1.02512E-05	-825.5091498	9.9827E-75	-0.00848326	-0.008441594

LOW CONCENTRATION DIFFUSION COEFFICIENT

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.997312275
R Square	0.994631773
Adjusted R Square	0.994625129
Standard Error	0.000662618
Observations	810

ANOVA

	df	SS	MS	F	Significance F
Regression	1	0.06573076	0.06573076	149707.254	0
Residual	808	0.000354762	4.39062E-07		
Total	809	0.066085522			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	0.20905919	0.000404425	516.9300144	0	0.208265344	0.209853037
X Variable 1	-0.000632674	1.63515E-06	-386.9202161	0	-0.000635884	-0.000629464

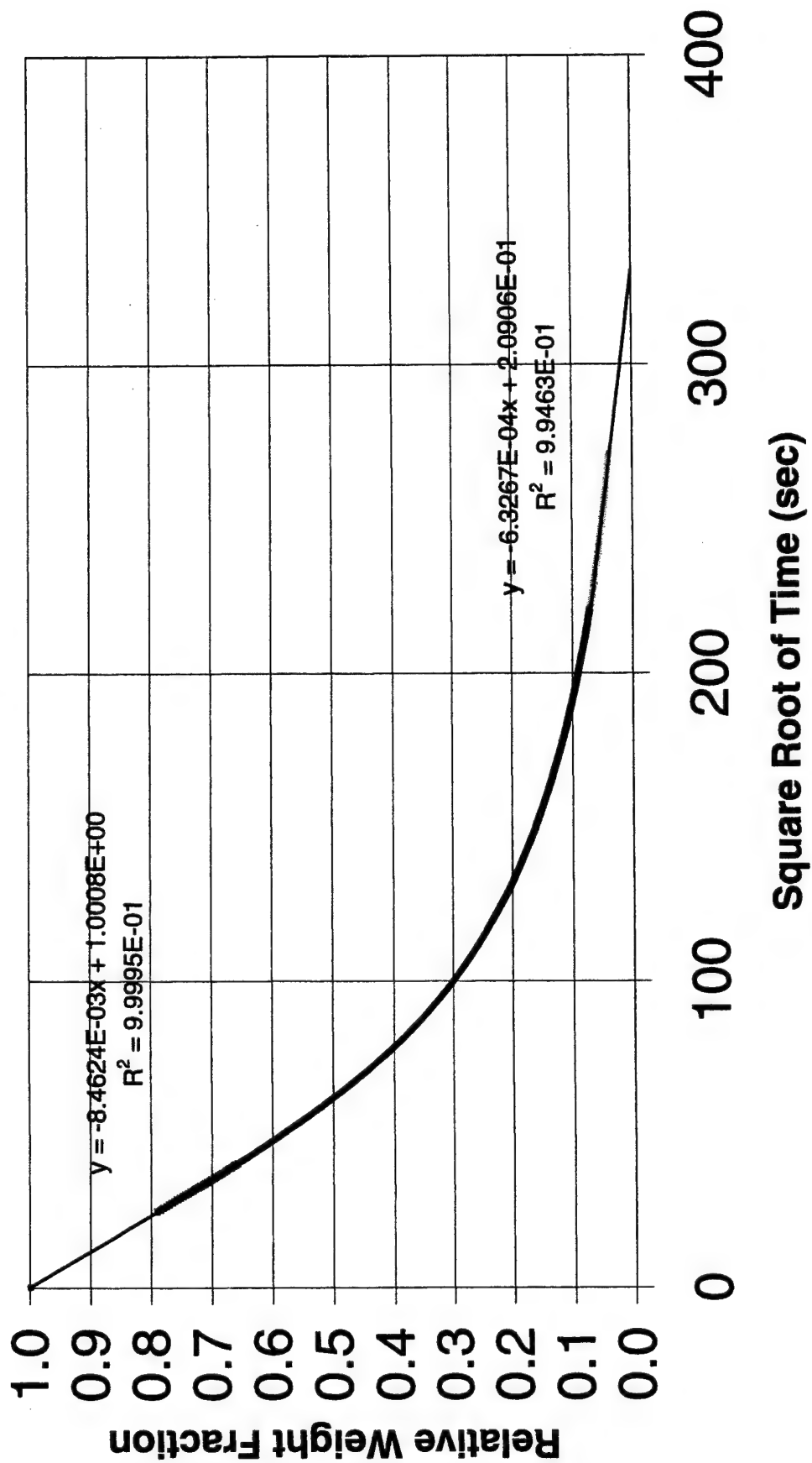
DIAMETER STATISTICS

<i>Column1</i>	
Mean	9.86
Standard Error	0.02677063
Median	9.865
Mode	#N/A
Standard Deviation	0.05354126
Sample Variance	0.00286667
Kurtosis	-4.3409951
Skewness	-0.2345507
Range	0.11
Minimum	9.8
Maximum	9.91
Sum	39.44
Count	4
Confidence Level(95.0%)	0.08519617

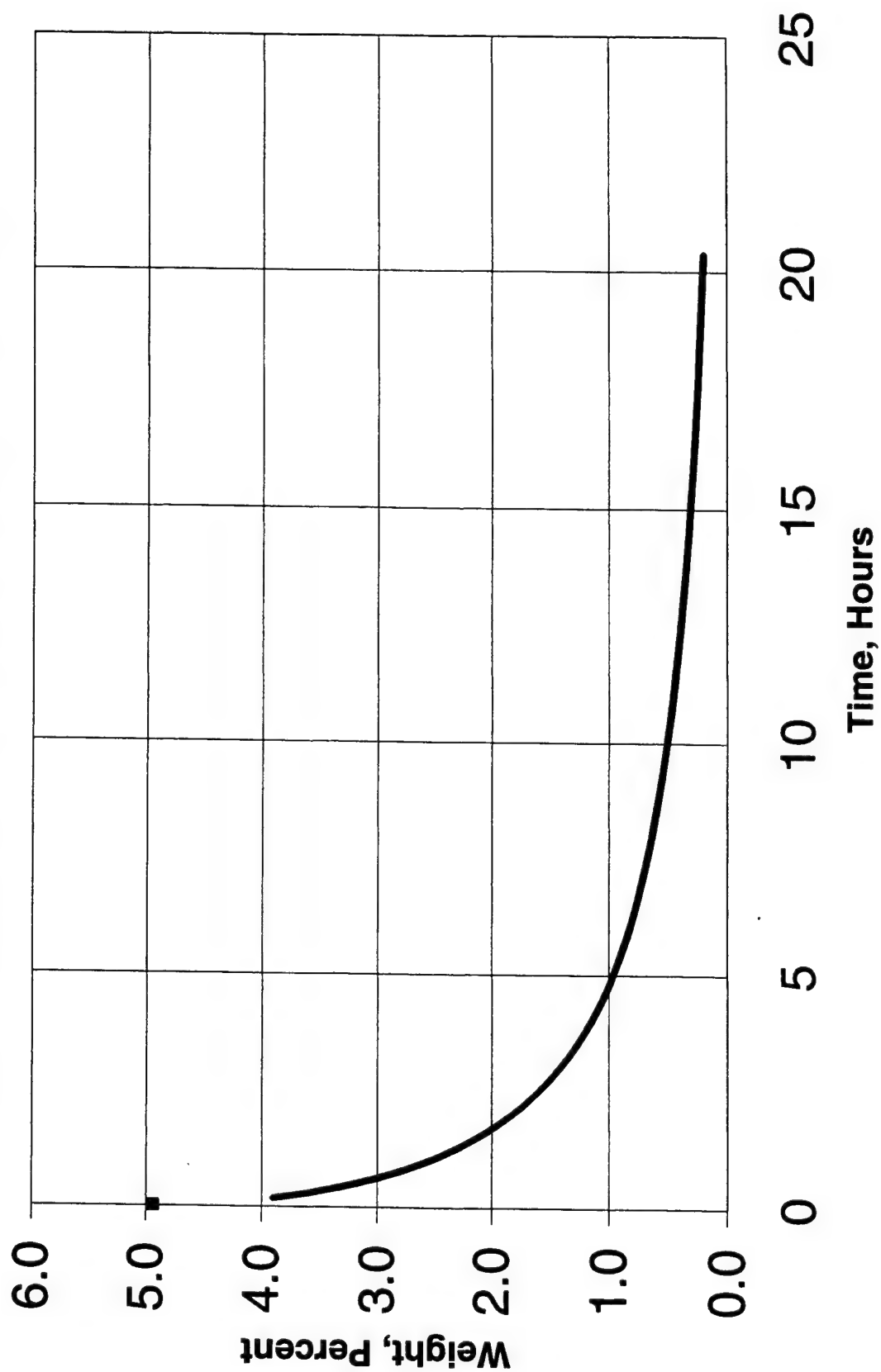
THICKNESS STATISTICS

<i>Column1</i>	
Mean	75
Standard Error	0.04082483
Median	75
Mode	75
Standard Deviation	0.08164966
Sample Variance	0.00666667
Kurtosis	1.5
Skewness	0
Range	0.2
Minimum	74.9
Maximum	75.1
Sum	300
Count	4
Confidence Level(95.0%)	0.12992295

**Figure . Fick's Law Plot of Desorption Diffusion (30 degrees C)
of Supercritical Carbon Dioxide from Polymeric Materials:
SMO (0129d)**



**Figure . Desorption Diffusion (30 degrees C) of Supercritical
Carbon Dioxide from Polymeric Materials: SMO (0129d)**



**Figure . Desorption Diffusion (30 degrees C) of Supercritical
Carbon Dioxide from Polymeric Materials: SMO (0129d)**

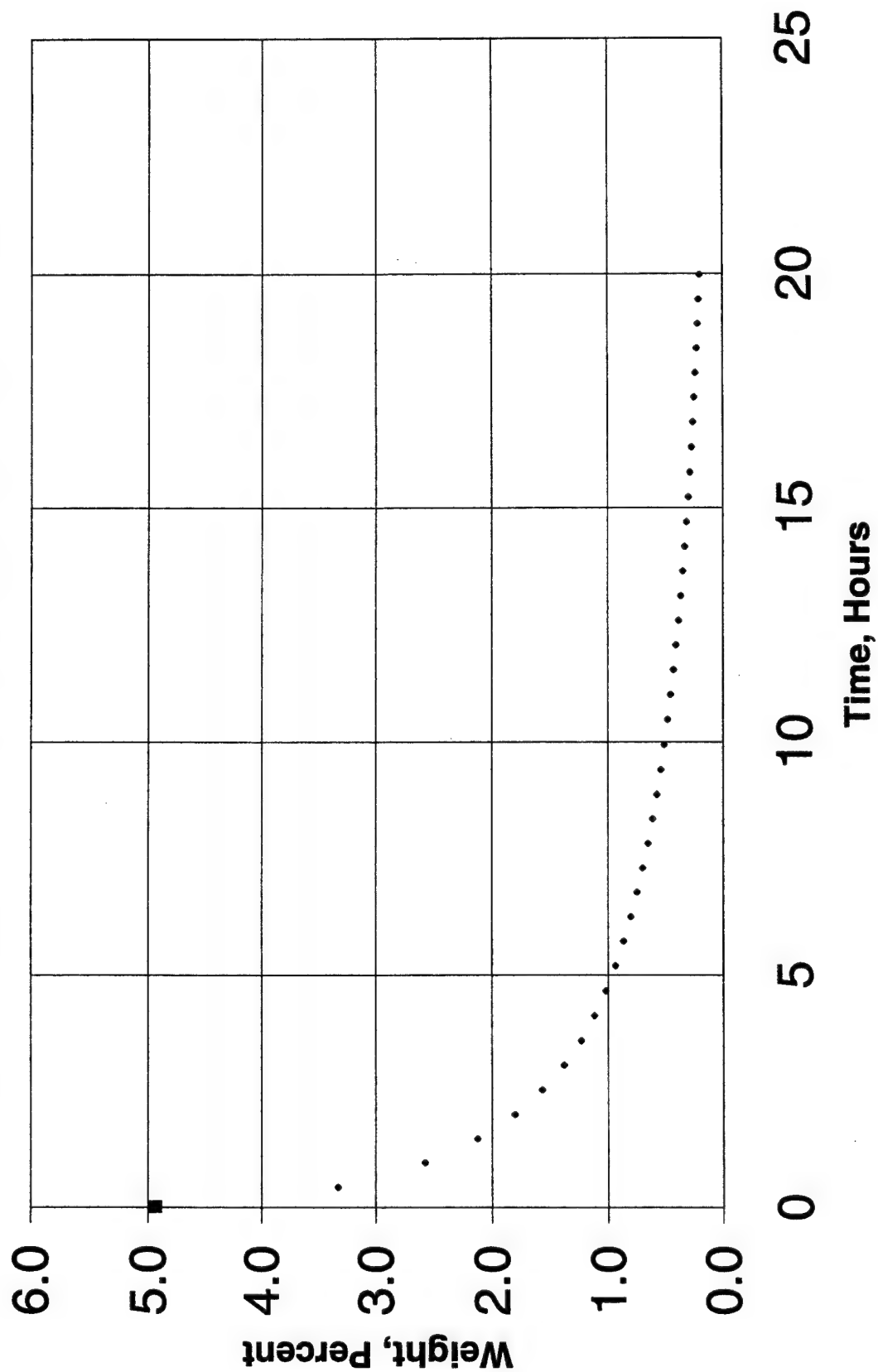
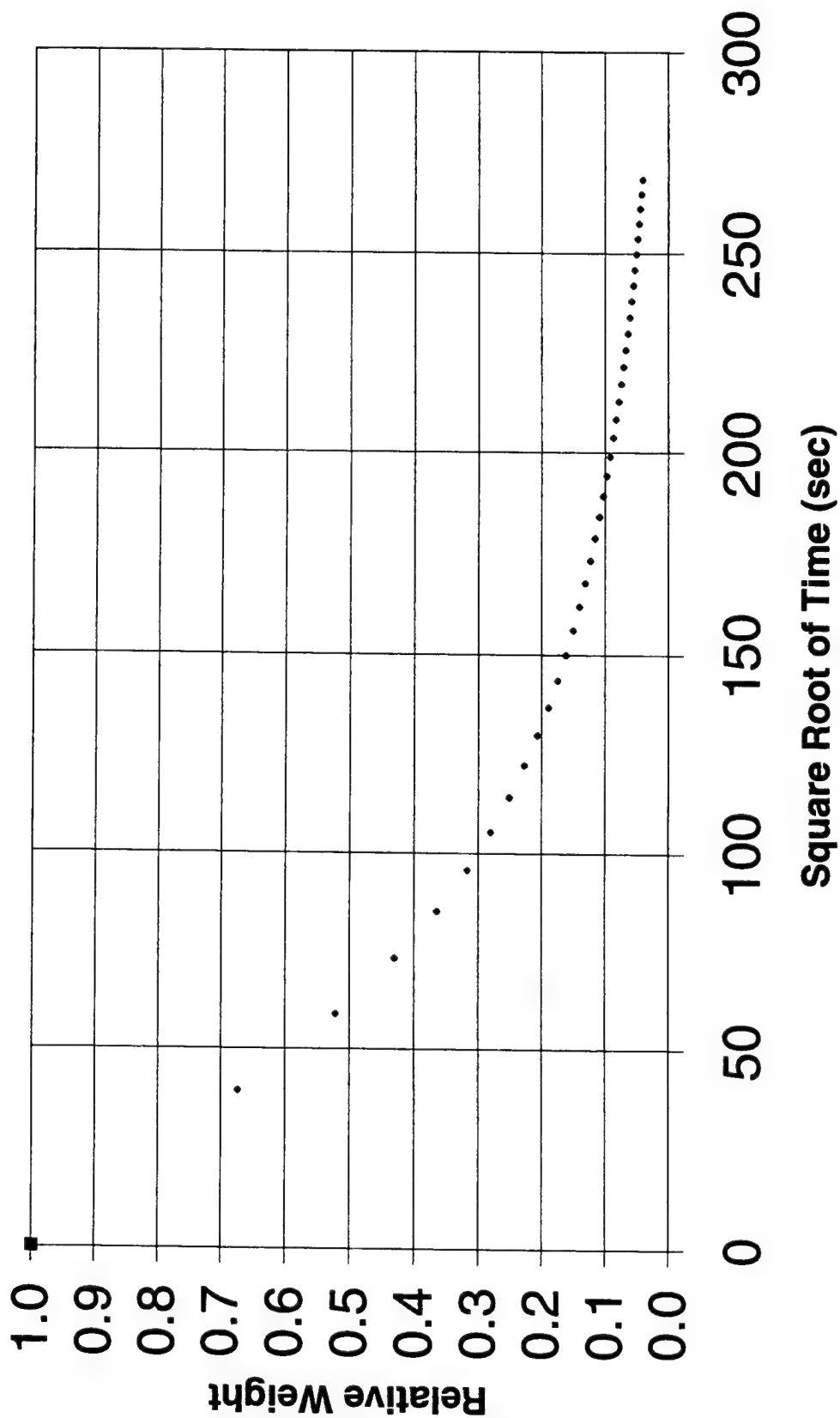


Figure . Fick's Law Plot of Desorption Diffusion (30 degrees C) of Supercritical Carbon Dioxide from Polymeric Materials: SMO (0129d)



TGA Time, min	Temp., deg C	TGA Wt., mg	TGA Time, sec	Adjusted Time, sec	Adjusted Time, hr	SQRT Adj. Time, sec	Wt. Loss, %	Fractional Wt. Loss	Wt. @ Zero Time, mg	Wt. @ Zero Time, %	TGA Dry Wt., mg	Adjustment to TGA Time, sec	Hardness Scale
A	B	C	D	E	F	G	H	I	J	K	L	M	N
15.749	29.995	153.404	944.940	1559.940	0.433	39.50	3.329	0.674	155.80	4.943	148.461	615	Shore A
47.420	30.000	152.291	2845.200	3460.200	0.961	58.82	2.580	0.522					
79.097	30.000	151.616	4745.820	5360.820	1.489	73.22	2.125	0.430					
110.807	30.001	151.143	6648.420	7263.420	2.018	85.23	1.807	0.365					
142.543	30.000	150.792	8552.580	9167.580	2.547	95.75	1.570	0.318					
174.253	30.000	150.519	10455.180	11070.180	3.075	105.21	1.386	0.280					
206.012	30.001	150.301	12360.720	12975.720	3.604	113.91	1.239	0.251					
237.705	30.000	150.125	14262.300	14877.300	4.133	121.97	1.121	0.227					
269.414	30.000	149.977	16164.840	16779.840	4.661	129.54	1.021	0.207					
301.101	30.000	149.851	18066.060	18681.060	5.189	136.68	0.936	0.189					
332.793	30.000	149.743	19967.580	20582.580	5.717	143.47	0.864	0.175					
364.478	30.001	149.648	21868.680	22483.680	6.245	149.95	0.800	0.162					
396.186	30.000	149.565	23771.160	24386.160	6.774	156.16	0.744	0.150					
427.866	30.000	149.492	25671.960	26286.960	7.302	162.13	0.694	0.140					
459.545	30.000	149.425	27572.700	28187.700	7.830	167.89	0.649	0.131					
491.228	30.001	149.366	29473.680	30088.680	8.358	173.46	0.610	0.123					
522.944	30.000	149.312	31376.640	31991.640	8.887	178.86	0.573	0.116					
554.827	30.000	149.261	33277.620	33892.620	9.415	184.10	0.539	0.109					
586.301	30.000	149.216	35178.060	35793.060	9.943	189.19	0.509	0.103					
618.012	30.000	149.173	37080.720	37695.720	10.471	194.15	0.480	0.097					
649.659	30.000	149.135	38981.940	39596.940	10.999	198.99	0.454	0.092					
681.383	30.000	149.098	40882.980	41497.980	11.527	203.71	0.429	0.087					
713.057	30.000	149.065	42783.420	43398.420	12.055	208.32	0.407	0.082					
744.757	30.000	149.033	44685.420	45300.420	12.583	212.84	0.385	0.078					
776.478	30.000	149.004	46588.680	47203.680	13.112	217.26	0.366	0.074					
808.167	30.000	148.977	48490.020	49105.020	13.640	221.60	0.348	0.070					
839.861	30.000	148.952	50391.660	51006.660	14.169	225.85	0.331	0.067					
871.534	30.000	148.928	52292.040	52907.040	14.696	230.02	0.315	0.064					
903.217	30.000	148.908	54193.020	54808.020	15.224	234.11	0.300	0.061					
934.902	30.000	148.885	56094.120	56709.120	15.753	238.14	0.286	0.058					
966.589	30.000	148.865	57995.340	58610.340	16.281	242.10	0.272	0.055					
998.272	30.000	148.847	59896.320	60511.320	16.809	245.99	0.260	0.053					
1029.960	30.001	148.829	61797.600	62412.600	17.337	249.83	0.248	0.050					
1061.642	29.999	148.813	63698.520	64313.520	17.865	253.60	0.237	0.048					
1093.338	30.001	148.797	65600.280	66215.280	18.393	257.32	0.226	0.046					
1125.067	30.000	148.783	67504.020	68119.020	18.922	261.00	0.217	0.044					
1156.749	30.000	148.769	69404.940	70019.940	19.450	264.61	0.207	0.042					
1188.439	30.000	148.756	71306.340	71921.340	19.978	268.18	0.199	0.040					

Formulae Used for Analysis of Data

Uppercase letters refer to columns

Lowercase n refers to row, beginning with n=4

$$Dn = (An * 60)$$

$$En = (Dn + M4)$$

$$Fn = (En / 3600)$$

$$Gn = SQRT(En)$$

$$Hn = (((Cn - L4) / L4) * 100)$$

$$In = (((Cn - L4) / (J4 - L4))$$

$$K4 = (((J4 - L4) / L4) * 100)$$

$$N16 = (((N12 - N8) / N8) * 100)$$

Source binary TA data file : smc0129d.01

14 lines in the parameter block

3 channels of data

Run 36

Module TGA Aluminum Pans

Sample SMO GPM SCCO2 0129D Disk

Size 154.274 mg

Method DESORPTION-Isothermal

Operator BSI

Comment :38"x.075",HP@1400x50,Dry:DS-148.3 M-148.54 TG-148.461 ET:10:15

Nsig 3

Sig1 Time (min)

Sig2 Temperature (°C)

Sig3 Weight (mg)

Kcell 1.0000

Date 8-May-00

Time 14:51

Blank

FIGURE . CHEMICAL-MATERIAL INTERACTION DATA SET:**Supercritical Carbon Dioxide and Polyethylene-propylene****PEP****Sorption, Desorption Diffusion, and Indentation Data Sets****Material Data**

Test Reference Number:	<u>08-1-1</u>	TGA Filename:	<u>pep0130d</u>
Property Test Specification:	ASTM D471/D543		
Material Name:	<u>Polyethylene-propylene</u>	Material Code:	<u>PEP</u>
Material Supplier:	<u>Smithers Scientific</u>	Material Class:	<u>EPM</u>
Monomer Source:	<u>Dupont</u>	Base Polymer (Lot. No.):	<u>Nordel 2744</u>
Exposure Liquid:	<u>Supercritical Carbon Dioxide</u>	Replicate Number:	<u>1</u>

Pre-Exposure Data

Measured Diameter (mm):	<u>9.82</u>	<u>9.87</u>	<u>9.81</u>	<u>9.87</u>	
Mean Diameter:	<u>9.845</u>				95% Confidence Level (CL): <u>0.051</u>
Measured Thickness (mils):	<u>48.40</u>	<u>48.50</u>	<u>49.20</u>	<u>48.60</u>	
Mean Thickness:	<u>48.675</u>				95% Confidence Level (CL): <u>0.572</u>
Initial Sample Weight (mg):	<u>114.050</u>				
Initial Durometer Hardness:	<u>93.6</u>	Scale: SHORE	<u>A</u>		

Sample Exposure Data

Exposure Date:	<u>05/09/00</u>	Time:	<u>11:21:00</u>	
Removal Date:	<u>05/09/00</u>	Time:	<u>11:36:00</u>	
Total Exposure Time (h:m:s):	<u>00:15:00</u>	Weight of Sample After Exposure (mg):	<u>117.60</u>	
Weight Gain (mg):	<u>3.55</u>	Percent Weight Gain:	<u>3.11</u>	
Final Durometer Hardness After Desorption:	<u>93.9</u>	Percent Hardness Change:	<u>0.3</u>	

Desorption Experiment

Mean Temperature of Desorption Experiment (setpoint = 30 deg C):	<u>30.000</u>	95% CL:	<u>0.0015</u>
Time Lapse Between Sample Exposure and Sample Desorption (sec):			<u>635</u>
Equilibrium Weight of Desorbed Sample at 30 deg C (mg):			<u>113.930</u>
Sample Extracted (mg):	<u>0.12</u>	Solubility Corrected for Extractables (mg):	<u>3.67</u>
Sample Extracted (%):	<u>0.11</u>	Solubility Corrected for Extractables (%):	<u>3.22</u>

Diffusion Coefficient Data: Fick's Law

High Concentration Diffusion Coefficient (cm ² /sec):	<u>1.1302E-06</u>
Range Including 0,1 Intercept, Relative Weight Fraction:	<u>1.00 - 0.30</u>
Linear Range of Desorption, Relative Weight Fraction:	<u>0.50 - 0.30</u>
Slope:	<u>-1.9405E-02</u>
X-axis Intercept:	<u>5.1234E+01</u>
R Square:	<u>0.99918</u>
Y-axis Intercept:	<u>9.9420E-01</u>
Low Concentration Diffusion Coefficient (cm ² /sec):	<u>5.7250E-11</u>
Linear Range of Desorption, Relative Weight Fraction:	<u>0.03 - 0.00</u>
Slope:	<u>-1.3811E-04</u>
X-axis Intercept:	<u>2.7238E+02</u>
R Square:	<u>0.96751</u>
Y-axis Intercept:	<u>3.7619E-02</u>

Wt. @ Zero Time, mg K 117.60	Wt. @ Zero Time, % L 3.113	Adjustment to TGA Time, sec M 635	Hardness Shore Scale N A
TGA Dry Wt., mg 114.050	Equil. Wt. Of Desorb. Sample 113.93	Min. Wt. Used For FDC, mg. 113.930	Pre Exposure Hardness 93.6
High Conc. DC, cm2/sec 1.1302E-06	Low Conc. DC, cm2/sec 5.7250E-11	Total Liquid Sorbed, mg. 3.550	Post Desorption Hardness 93.9
R Square 0.99918	R Square 0.96751		Change in Hardness, % 0.3
X Intercept 51.23	X Intercept 272.4		Mean Thickness, cm. 0.1236
Y Intercept 0.99420	Y Intercept 0.03762		
Y Intercept as Wt., mg. 116.918	X Intercept as Time, hrs. 20.6	X Intercept as Time, min. 123.7	pep0130d X Intercept as Time, days 0.9

TEMPERATURE STATISTICS

<i>Column1</i>		Max. TGA Wt., (orig data file) 115.799	TGA Wt. At 20 min. Adjustment 115.116
Mean	30.00029496	Sorption @ 7-12 min., mg	Sorption @ 20 min., mg
Standard Error	0.000777476	1.75	1.07
Median	30		
Mode	30	Sorption @ 7-12	Sorption @ 20
Standard Deviation	0.040540732	min., %	min., %
Sample Variance	0.001643551	1.53	0.93
Kurtosis	367.9197048		
Skewness	-11.59879076	Rel. Error (%) of	Rel. Error (%) of
Range	1.577	7-12 min. Sorp.	20 min. Sorp
Minimum	28.823	-50.7	-70.0
Maximum	30.4		
Sum	81570.802		
Count	2719		
Confidence Level(95.0%)	0.001524505		

DIAMETER STATISTICS

<i>Column1</i>	
Mean	9.8425
Standard Error	0.01600781
Median	9.845
Mode	9.87
Standard Deviation	0.03201562
Sample Variance	0.001025
Kurtosis	-5.518144
Skewness	-0.0838006
Range	0.06
Minimum	9.81
Maximum	9.87
Sum	39.37
Count	4
Confidence Level(95.0%)	0.05094405

ND/value
ND/value
A/D

THICKNESS STATISTICS

<i>Column1</i>	
Mean	48.675
Standard Error	0.17969882
Median	48.55
Mode	#N/A
Standard Deviation	0.35939764
Sample Variance	0.12916667
Kurtosis	3.01436004
Skewness	1.6963868
Range	0.8
Minimum	48.4
Maximum	49.2
Sum	194.7
Count	4
Confidence Level(95.0%)	0.57188239

Nordel 2744
pep0130d

HIGH CONCENTRATION DIFFUSION COEFFICIENT

pep0130d

SUMMARY OUTPUT

<i>Regression Statistics</i>	
Multiple R	0.999591299
R Square	0.999182765
Adjusted R Square	0.999147233
Standard Error	0.004020398
Observations	25

ANOVA

	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	1	0.4545315	0.4545315	28120.6817	5.11105E-37
Residual	23	0.000371763	1.61636E-05		
Total	24	0.454903263			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>
Intercept	0.994201567	0.003567351	278.694592	4.3336E-42	0.986821948	1.001581186
X Variable 1	-0.019405033	0.000115718	-167.692223	5.111E-37	-0.019644414	-0.019165652

LOW CONCENTRATION DIFFUSION COEFFICIENT

SUMMARY OUTPUT

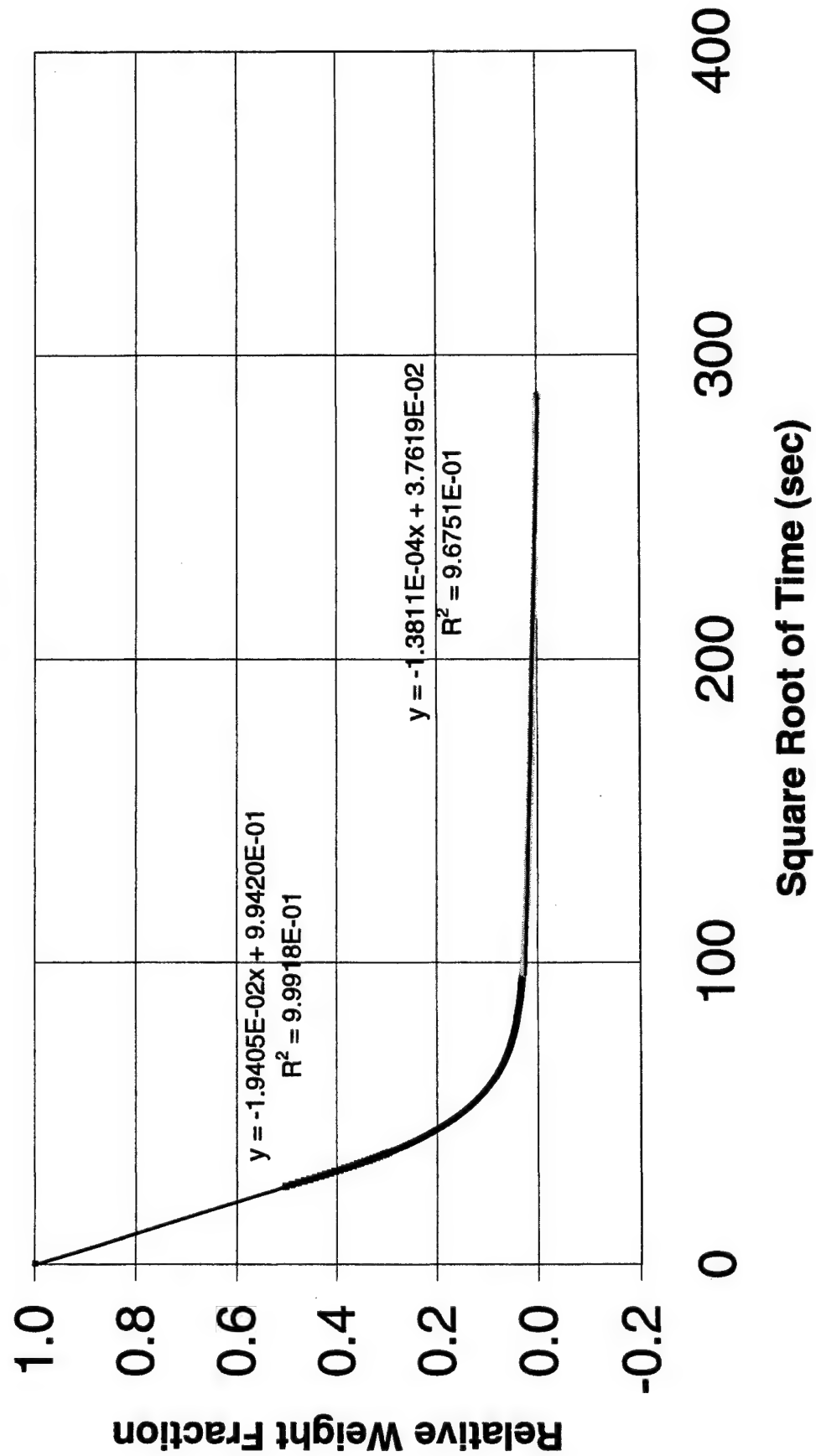
<i>Regression Statistics</i>	
Multiple R	0.983619271
R Square	0.96750687
Adjusted R Square	0.967493509
Standard Error	0.001336773
Observations	2434

ANOVA

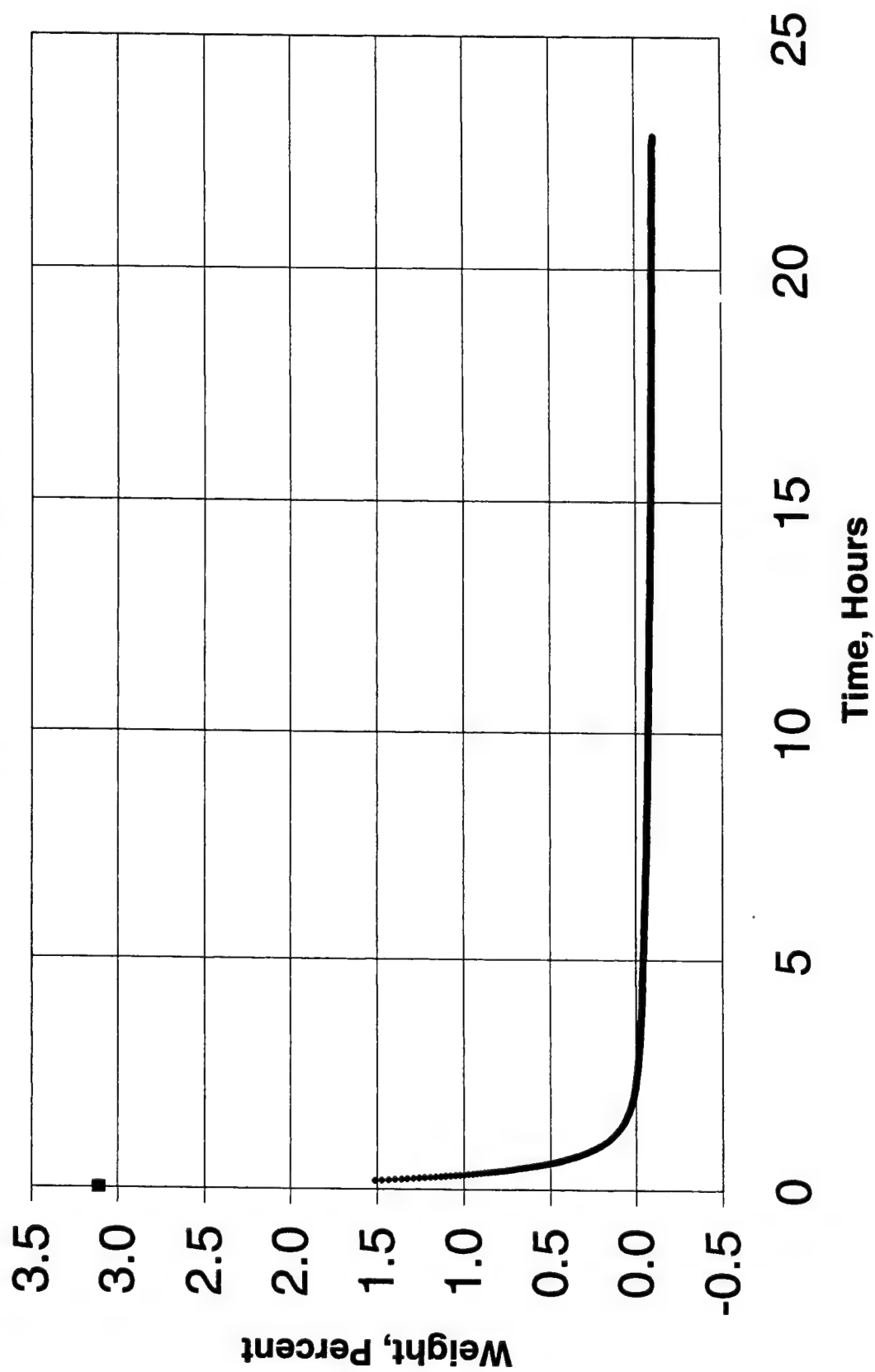
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	1	0.129402078	0.129402078	72414.5898	0
Residual	2432	0.00434589	1.78696E-06		
Total	2433	0.133747969			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>
Intercept	0.03761904	0.000109758	342.7448567	0	0.037403811	0.037834269
X Variable 1	-0.000138113	5.1324E-07	-269.0995908	0	-0.000139119	-0.000137106

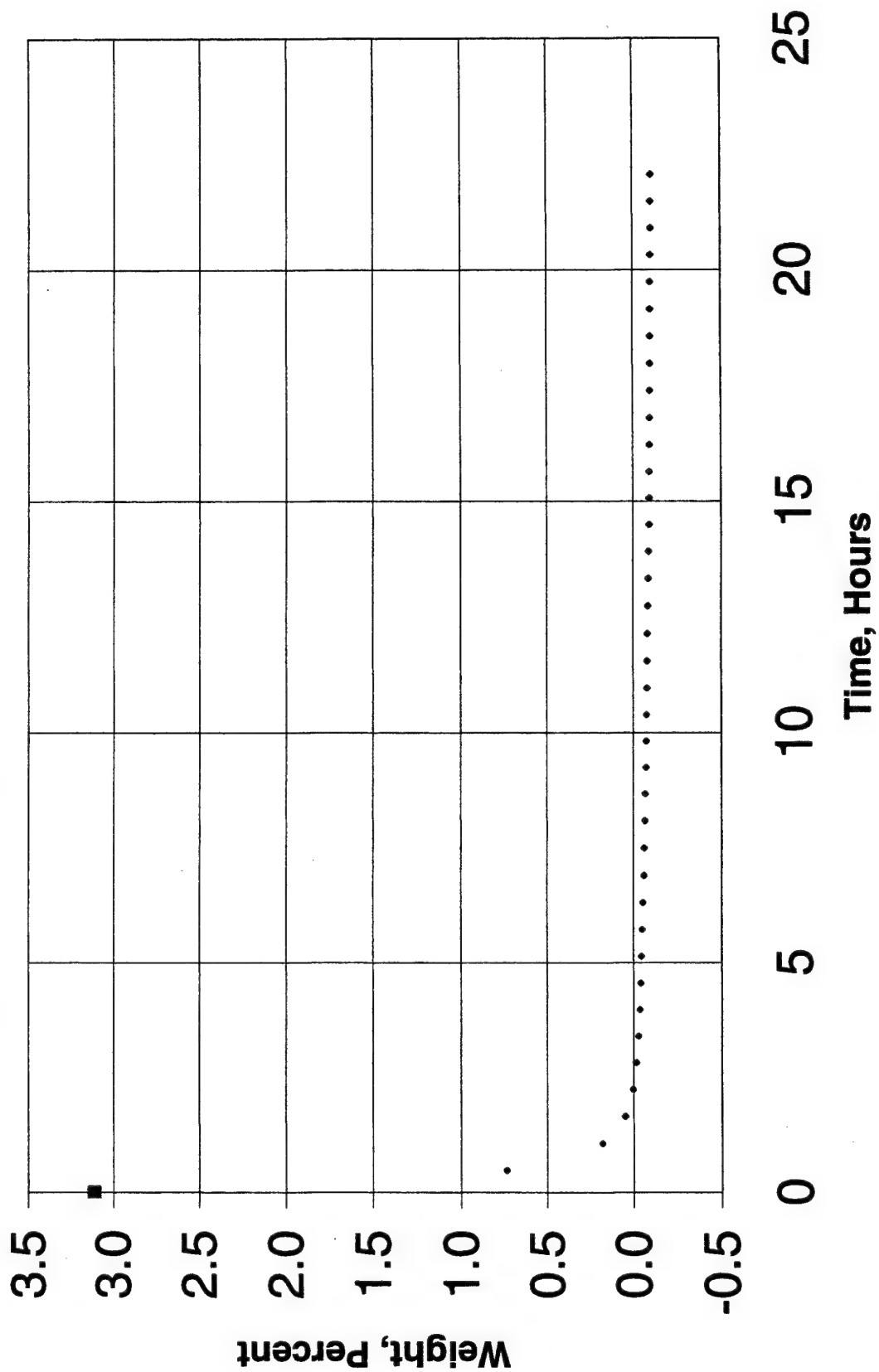
**Figure . Fick's Law Plot of Desorption Diffusion (30 degrees C)
of Supercritical Carbon Dioxide from Polymeric Materials:
PEP (0130d)**



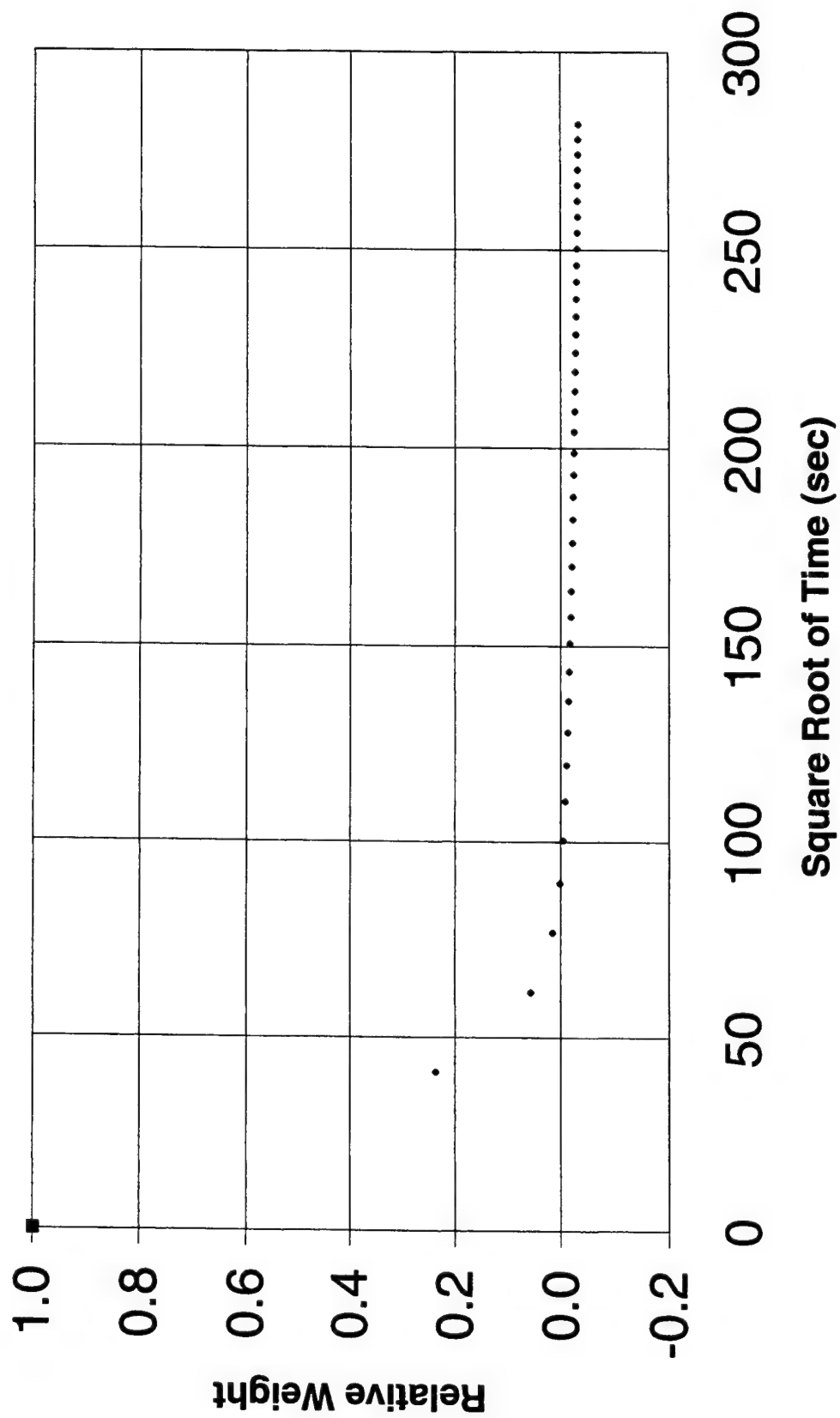
**Figure . Desorption Diffusion (30 degrees C) of Supercritical
Carbon Dioxide from Polymeric Materials: PEP (0130d)**



**Figure . Desorption Diffusion (30 degrees C) of Supercritical
Carbon Dioxide from Polymeric Materials: PEP (0130d)**



**Figure . Fick's Law Plot of Desorption Diffusion (30 degrees C) of
Supercritical Carbon Dioxide from Polymeric Materials:
PEP (0130d)**



TGA Time, min	Temp., deg C	TGA Wt., mg	TGA Time, sec	Adjusted Time, sec	Adjusted Time, hr	SQRT Adj. Time, sec	Wt. Loss, %	Fractional Wt. Loss	Wt. @ Zero Time, mg	Wt. @ Zero Time, %	TGA Dry Wt., mg	Adjustment to TGA Time, sec	Hardness Scale
A	B	C	D	E	F	G	H	I	J	K	L	M	N
17.430	30.007	114.891	1045.800	1680.800	0.467	41.00	0.737	0.237	117.60	3.112	114.051	635	Shore A
52.461	30.000	114.254	3147.660	3782.660	1.051	61.50	0.178	0.057					
87.495	30.000	114.106	5249.700	5884.700	1.635	76.71	0.048	0.015					
122.519	30.000	114.056	7351.140	7986.140	2.218	89.37	0.004	0.001					
157.568	30.000	114.034	9454.080	10089.080	2.803	100.44	-0.015	-0.005					
192.620	30.000	114.021	11557.200	12192.200	3.387	110.42	-0.026	-0.008					
227.663	30.000	114.012	13659.780	14294.780	3.971	119.56	-0.034	-0.011					
262.691	30.000	114.006	15761.460	16396.460	4.555	128.05	-0.039	-0.013					
297.733	30.000	114.000	17863.980	18498.980	5.139	136.01	-0.045	-0.014					
332.744	30.000	113.995	19964.640	20599.640	5.722	143.53	-0.049	-0.016					
367.764	30.000	113.990	22065.840	22700.840	6.306	150.67	-0.053	-0.017					
402.795	30.000	113.984	24167.700	24802.700	6.890	157.49	-0.059	-0.019					
437.841	30.000	113.981	26270.460	26905.460	7.474	164.03	-0.061	-0.020					
472.875	30.000	113.978	28372.500	29007.500	8.058	170.32	-0.064	-0.021					
507.955	30.001	113.974	30477.300	31112.300	8.642	176.39	-0.068	-0.022					
542.981	30.000	113.970	32578.860	33213.860	9.226	182.25	-0.071	-0.023					
578.016	30.000	113.968	34680.960	35315.960	9.810	187.93	-0.073	-0.023					
613.051	30.000	113.965	36783.060	37418.060	10.394	193.44	-0.075	-0.024					
648.066	30.000	113.963	38883.960	39518.960	10.977	198.79	-0.077	-0.025					
683.092	30.000	113.961	40985.520	41620.520	11.561	204.01	-0.079	-0.025					
718.112	30.000	113.958	43086.720	43721.720	12.145	209.10	-0.082	-0.026					
753.136	30.001	113.955	45188.160	45823.160	12.729	214.06	-0.084	-0.027					
788.141	30.000	113.953	47288.460	47923.460	13.312	218.91	-0.086	-0.028					
823.159	30.001	113.951	49389.540	50024.540	13.896	223.66	-0.088	-0.028					
858.199	30.000	113.949	51491.940	52126.940	14.480	228.31	-0.089	-0.029					
893.241	30.001	113.947	53594.460	54229.460	15.064	232.87	-0.091	-0.029					
928.271	30.000	113.946	55696.260	56331.260	15.648	237.34	-0.092	-0.030					
963.296	29.999	113.944	57797.760	58432.760	16.231	241.73	-0.094	-0.030					
998.316	30.000	113.943	59898.960	60533.960	16.815	246.04	-0.095	-0.030					
1033.356	30.000	113.941	62001.360	62636.360	17.399	250.27	-0.096	-0.031					
1068.370	30.000	113.940	64102.200	64737.200	17.983	254.44	-0.097	-0.031					
1103.416	30.000	113.938	66204.960	66839.960	18.567	258.53	-0.099	-0.032					
1138.457	30.000	113.937	68307.420	68942.420	19.151	262.57	-0.100	-0.032					
1173.515	30.000	113.937	70410.900	71045.900	19.735	266.54	-0.100	-0.032					
1208.562	30.000	113.936	72513.720	73148.720	20.319	270.46	-0.101	-0.032					
1243.609	30.000	113.934	74616.540	75251.540	20.903	274.32	-0.103	-0.033					
1278.711	30.000	113.934	76722.660	77357.660	21.488	278.13	-0.103	-0.033					
1313.760	30.000	113.932	78825.600	79460.600	22.072	281.89	-0.104	-0.034					

Formulae Used for Analysis of Data

Uppercase letters refer to columns

Lowercase n refers to row, beginning with n=4

Dn = (An * 60)

En = (Dn + M4)

Fn = (En / 3600)

Gn = SQRT (En)

Hn = (((Cn - L4) / L4) * 100)

In = (((J4 - L4) / (J4 - L4))

K4 = (((J4 - L4) / L4) * 100)

N16 = (((N12 - N8) / N8) * 100)

Source binary TA data file : pep0130d.01

14 lines in the parameter block

3 channels of data

Run 37

Module TGA Aluminum Pans

Sample PEP Mask SCO2 0130D Disk

Size 115.799 mg

Method DESORPTION-Isothermal

Operator ws

Comment :38"x.04",HP@1400x50,Dry:DS-114.1 M-114.19 TG-114.051 ET:10:35

Nsig 3

Sig1 Time (min)

Sig2 Temperature (eC)

Sig3 Weight (mg)

Kcell 1.0000

Date 9-May-00

Time 11:47

Blank

FIGURE . CHEMICAL-MATERIAL INTERACTION DATA SET:**Supercritical Carbon Dioxide and Polystyrene-butadiene****PSBR****Sorption, Desorption Diffusion, and Indentation Data Sets****Material Data**

Test Reference Number:	<u>14-1-1</u>	TGA Filename:	<u>psbr143z</u>
Property Test Specification:	ASTM D471/D543		
Material Name:	<u>Polystyrene-butadiene</u>	Material Code:	<u>PSBR</u>
Material Supplier:	<u>Smithers Scientific</u>	Material Class:	<u>SBR</u>
Monomer Source:	<u>DuPont</u>	Base Polymer (Lot. No.):	<u>Unknown</u>
Exposure Liquid:	<u>Supercritical Carbon Dioxide</u>	Replicate Number:	<u>1</u>

Pre-Exposure Data

Measured Diameter (mm):	<u>8.61</u>	<u>8.54</u>	<u>8.64</u>	<u>8.63</u>	
Mean Diameter:	<u>8.620</u>				
Measured Thickness (mils):	<u>40.70</u>	<u>40.60</u>	<u>40.90</u>	<u>40.90</u>	
Mean Thickness:	<u>40.775</u>				
Initial Sample Weight (mg):	<u>70.370</u>				
Initial Durometer Hardness:	<u>85.8</u>	Scale: SHORE	<u>A</u>		
					95% Confidence Level (CL): <u>0.072</u>
					95% Confidence Level (CL): <u>0.239</u>

Sample Exposure Data

Exposure Date:	<u>05/22/00</u>	Time:	<u>14:02:00</u>	
Removal Date:	<u>05/22/00</u>	Time:	<u>14:17:00</u>	
Total Exposure Time (h:m:s):	<u>00:15:00</u>	Weight of Sample After Exposure (mg):	<u>75.00</u>	
Weight Gain (mg):	<u>4.63</u>	Percent Weight Gain:	<u>6.58</u>	
Final Durometer Hardness After Desorption:	<u>87.1</u>	Percent Hardness Change:	<u>1.5</u>	

Desorption Experiment

Mean Temperature of Desorption Experiment (setpoint = 30 deg C):	<u>30.002</u>	95% CL:	<u>0.0006</u>
Time Lapse Between Sample Exposure and Sample Desorption (sec):			<u>430</u>
Equilibrium Weight of Desorbed Sample at 30 deg C (mg):			<u>69.850</u>
Sample Extracted (mg):	<u>0.52</u>	Solubility Corrected for Extractables (mg):	<u>5.15</u>
Sample Extracted (%):	<u>0.74</u>	Solubility Corrected for Extractables (%):	<u>7.32</u>

Diffusion Coefficient Data: Fick's Law

High Concentration Diffusion Coefficient (cm ² /sec):	<u>7.8964E-07</u>
Range Including 0,1 Intercept, Relative Weight Fraction:	<u>1.00 - 0.46</u>
Linear Range of Desorption, Relative Weight Fraction:	<u>0.60 - 0.46</u>
Slope:	<u>-1.9363E-02</u>
X-axis Intercept:	<u>5.1626E+01</u>
R Square:	<u>0.99994</u>
Y-axis Intercept:	<u>9.9963E-01</u>

Low Concentration Diffusion Coefficient (cm ² /sec):	<u>9.3694E-11</u>
Linear Range of Desorption, Relative Weight Fraction:	<u>0.05 - 0.00</u>
Slope:	<u>-2.1092E-04</u>
X-axis Intercept:	<u>3.8201E+02</u>
R Square:	<u>0.99137</u>
Y-axis Intercept:	<u>8.0573E-02</u>

Wt. @ Zero Time, mg K 75.00	Wt. @ Zero Time, % L 6.580	Adjustment to TGA Time, sec M 430	Hardness Shore Scale N A
TGA Dry Wt., mg 70.370	Equil. Wt. Of Desorb. Sample 69.85	Min. Wt. Used For FDC, mg. 69.850	Pre Exposure Hardness 85.8
High Conc. DC, cm2/sec 7.8964E-07	Low Conc. DC, cm2/sec 9.3694E-11	Total Liquid Sorbed, mg. 4.630	Post Desorption Hardness 87.1
R Square 0.99994	R Square 0.99137		Change in Hardness, % 1.5
X Intercept 51.63	X Intercept 382.0		Mean Thickness, cm. 0.1036
Y Intercept 0.99963	Y Intercept 0.08057		
Y Intercept as Wt., mg. 74.972	X Intercept as Time, hrs. 40.5	X Intercept as Time, min. 243.2	psbr143z X Intercept as Time, days 1.7

TEMPERATURE STATISTICS

<i>Column1</i>		Max. TGA Wt., (orig data file) 72.951	TGA Wt. At 20 min. Adjustment 71.683
Mean	30.00189014	Sorption @ 7-12 min., mg	Sorption @ 20 min., mg
Standard Error	0.000306054	2.58	1.31
Median	30.002		
Mode	30.002	Sorption @ 7-12 min., %	Sorption @ 20 min., %
Standard Deviation	0.017544129	3.67	1.87
Sample Variance	0.000307796		
Kurtosis	818.301557	Rel. Error (%) of 7-12 min. Sorp.	Rel. Error (%) of 20 min. Sorp
Skewness	-22.99612249	-44.3	-71.6
Range	0.845		
Minimum	29.327		
Maximum	30.172		
Sum	98586.211		
Count	3286		
Confidence Level(95.0%)	0.000600077		

DIAMETER STATISTICS

<i>Column1</i>	
Mean	8.605
Standard Error	0.02254625
Median	8.62
Mode	#N/A
Standard Deviation	0.0450925
Sample Variance	0.00203333
Kurtosis	2.41709218
Skewness	-1.5705422
Range	0.1
Minimum	8.54
Maximum	8.64
Sum	34.42
Count	4
Confidence Level(95.0%)	0.07175229

ND/value
ND/value
A/D

THICKNESS STATISTICS

<i>Column1</i>	
Mean	40.775
Standard Error	0.075
Median	40.8
Mode	40.9
Standard Deviation	0.15
Sample Variance	0.0225
Kurtosis	-3.9012346
Skewness	-0.3703704
Range	0.3
Minimum	40.6
Maximum	40.9
Sum	163.1
Count	4
Confidence Level(95.0%)	0.2386837

Unknown
psbr143z

HIGH CONCENTRATION DIFFUSION COEFFICIENT

psbr143z

SUMMARY OUTPUT

<i>Regression Statistics</i>	
Multiple R	0.999968753
R Square	0.999937507
Adjusted R Square	0.999932299
Standard Error	0.00111621
Observations	14

ANOVA

	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	1	0.239229675	0.239229675	192009.759	1.34372E-26
Residual	12	1.49511E-05	1.24592E-06		
Total	13	0.239244627			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>
Intercept	0.999631372	0.001060248	942.8274908	1.3651E-30	0.997321289	1.001941455
X Variable 1	-0.019362959	4.41886E-05	-438.1891819	1.3437E-26	-0.019459237	-0.01926668

LOW CONCENTRATION DIFFUSION COEFFICIENT

SUMMARY OUTPUT

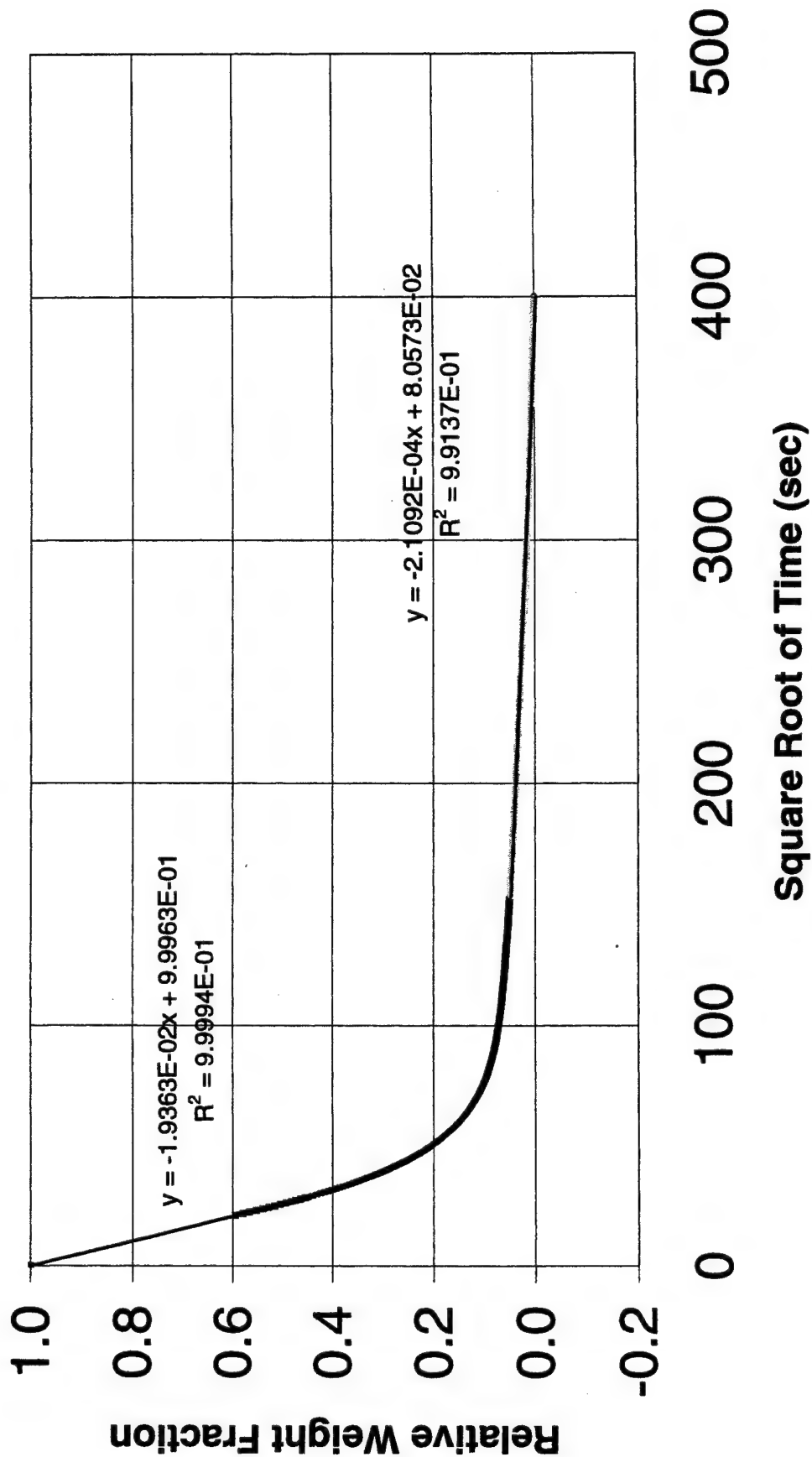
<i>Regression Statistics</i>	
Multiple R	0.995673175
R Square	0.991365072
Adjusted R Square	0.991361632
Standard Error	0.001147306
Observations	2512

ANOVA

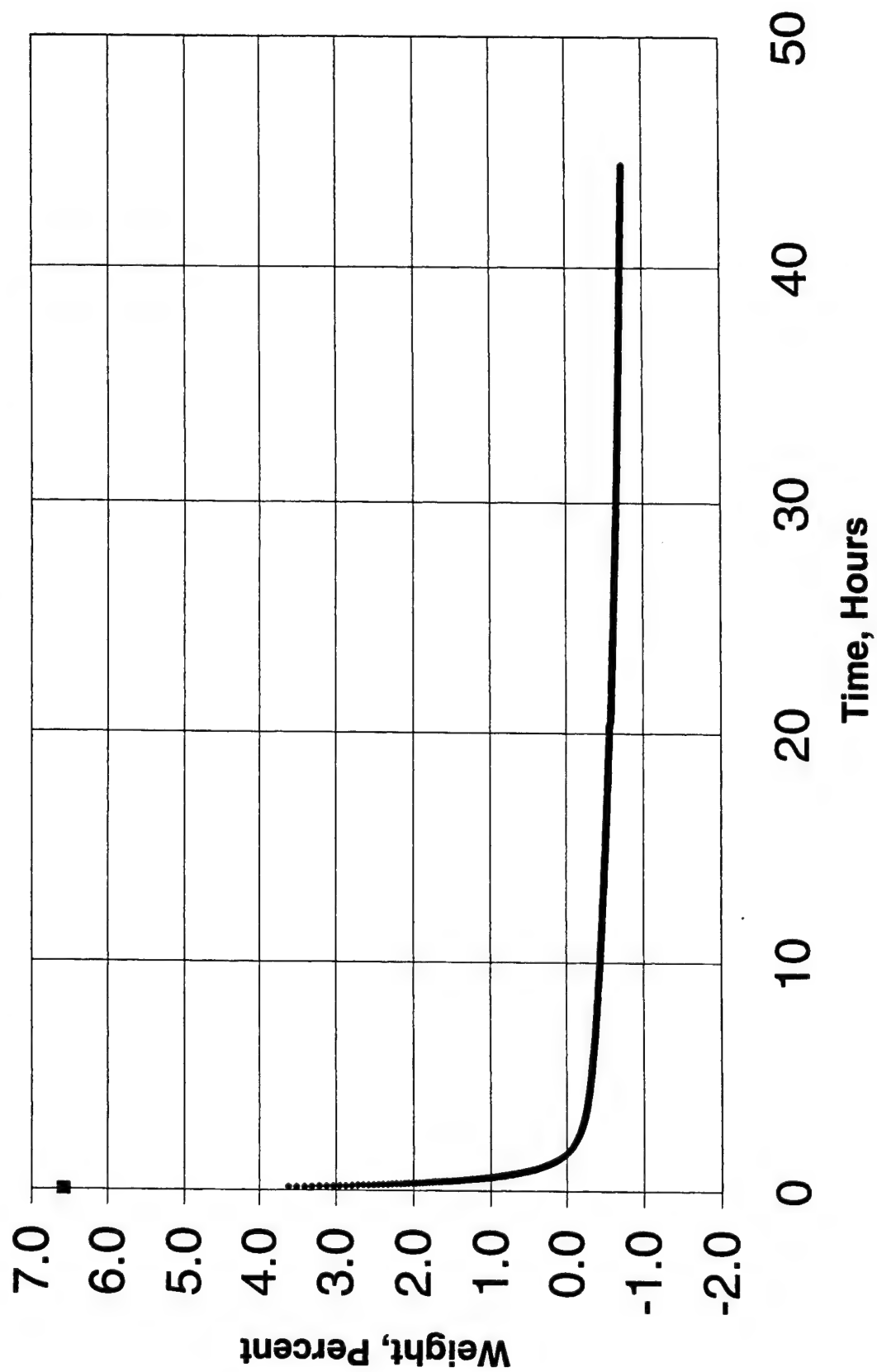
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	1	0.37932119	0.37932119	288169.893	0
Residual	2510	0.003303941	1.31631E-06		
Total	2511	0.38262513			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>
Intercept	0.080573277	0.000101198	796.1964679	0	0.080374838	0.080771717
X Variable 1	-0.000210918	3.92907E-07	-536.81458	0	-0.000211689	-0.000210148

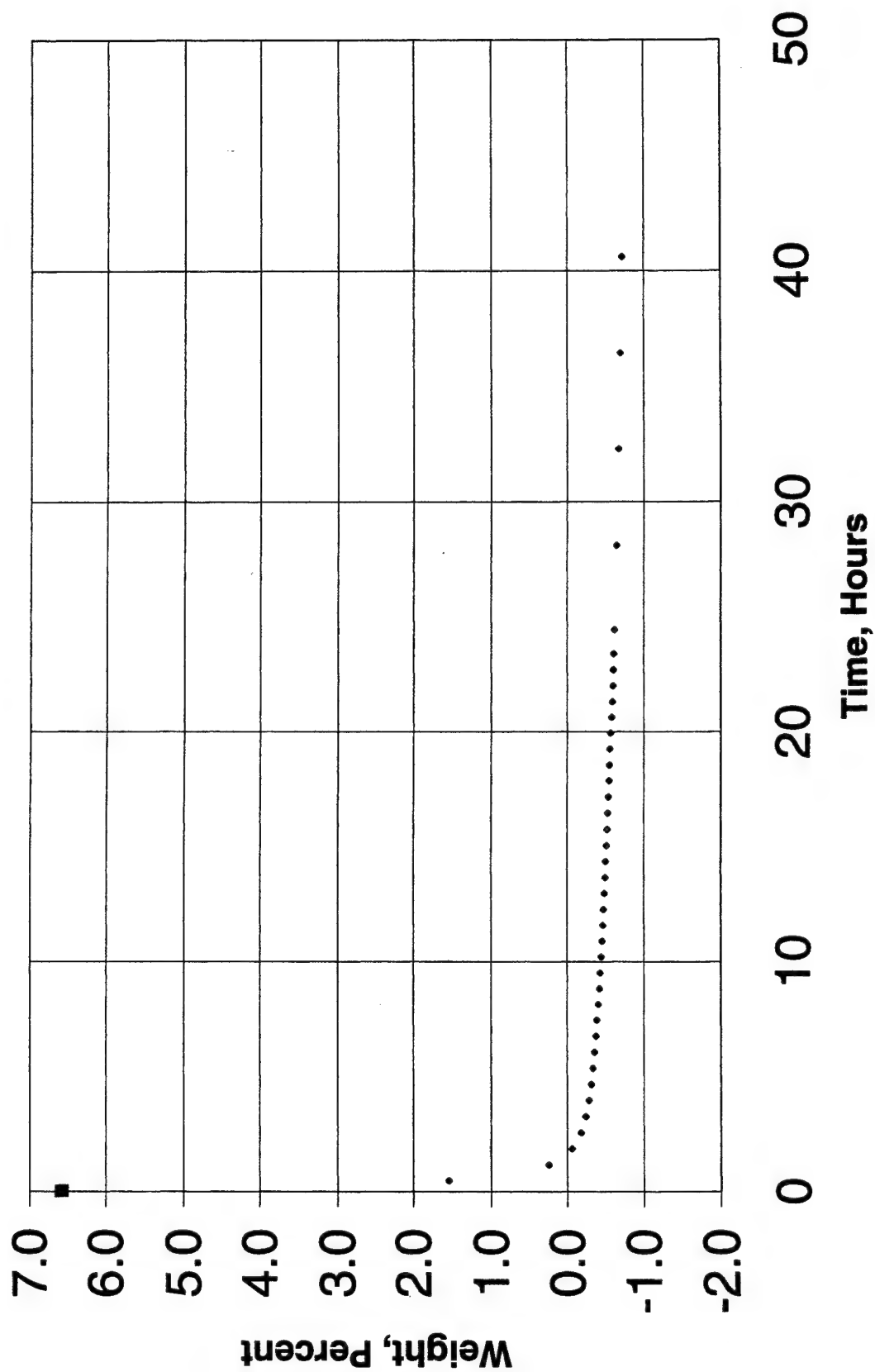
**Figure . Fick's Law Plot of Desorption Diffusion (30 degrees C)
of Supercritical Carbon Dioxide from Polymeric Materials:
PSBR (143z)**



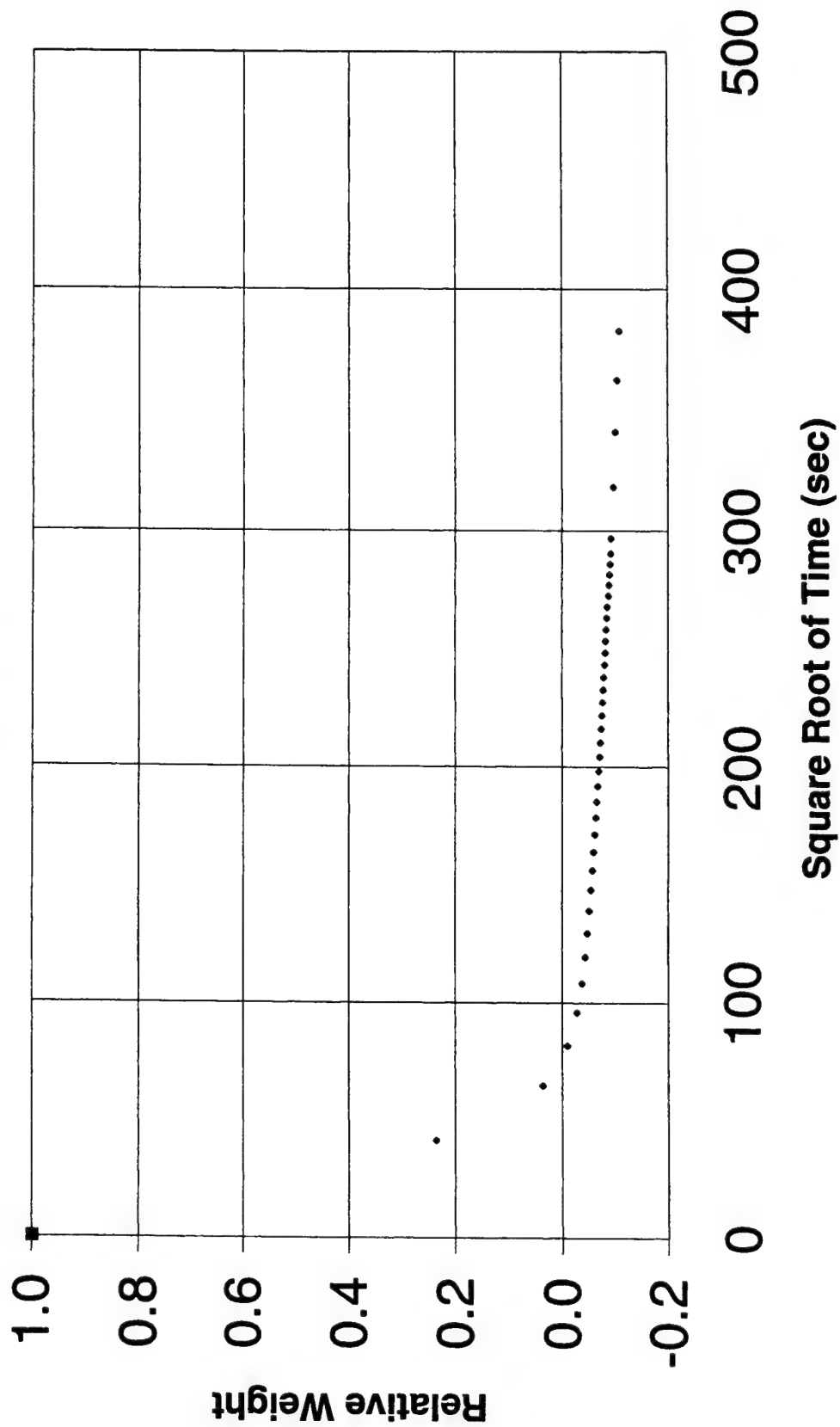
**Figure . Desorption Diffusion (30 degrees C) of Supercritical
Carbon Dioxide from Polymeric Materials: PSBR (143z)**



**Figure . Desorption Diffusion (30 degrees C) of Supercritical
Carbon Dioxide from Polymeric Materials: PSBR (143z)**



**Figure . Fick's Law Plot of Desorption Diffusion (30 degrees C) of
Supercritical Carbon Dioxide from Polymeric Materials:
PSBR (143z)**



TGA Time, min A	Temp., deg C B	TGA Wt., mg C	TGA Time, sec D	Adjusted Time, sec E	Adjusted Time, hr F	Sort Adj. Time, sec G	Wt. Loss, % H	Fractional Wt. Loss I	Wt. @ Zero Time, mg J	Wt. @ Zero Time, % K	TGA Dry Wt., mg L	Adjustment to TGA Time, sec M	Hardness Scale N
20.762	29.992	71.461	1245.720	1675.720	0.465	40.94	1.552	0.236	75.00	6.581	70.369	430	Shore A
62.452	30.000	70.540	3747.120	4177.120	1.160	64.63	0.243	0.037					
104.133	30.001	70.326	6247.980	6677.980	1.855	81.72	-0.062	-0.009					
145.931	30.002	70.242	8749.860	9179.860	2.550	95.81	-0.180	-0.027					
187.585	30.001	70.199	11255.100	11685.100	3.246	108.10	-0.242	-0.037					
229.334	30.001	70.171	13760.040	14190.040	3.942	119.12	-0.281	-0.043					
271.057	30.001	70.151	16263.420	16693.420	4.637	129.20	-0.310	-0.047					
312.798	30.001	70.134	18767.880	19197.880	5.333	138.56	-0.334	-0.051					
354.499	30.002	70.120	21269.940	21699.940	6.028	147.31	-0.354	-0.054					
396.221	30.001	70.107	23773.260	24203.260	6.723	155.57	-0.372	-0.057					
437.964	30.002	70.096	26277.840	26707.840	7.419	163.43	-0.388	-0.059					
479.741	30.002	70.086	28784.460	29214.460	8.115	170.92	-0.403	-0.061					
521.439	30.002	70.076	31286.340	31716.340	8.810	178.09	-0.416	-0.063					
563.125	30.002	70.067	33787.500	34217.500	9.505	184.98	-0.429	-0.065					
604.814	30.002	70.059	36288.840	36718.840	10.200	191.62	-0.441	-0.067					
646.521	30.003	70.051	38791.260	39221.260	10.895	198.04	-0.452	-0.069					
688.215	30.003	70.043	41292.900	41722.900	11.590	204.26	-0.463	-0.070					
729.891	30.002	70.036	43793.460	44223.460	12.284	210.29	-0.473	-0.072					
771.627	30.002	70.029	46297.820	46727.820	12.980	216.17	-0.483	-0.073					
813.368	30.002	70.023	48802.080	49232.080	13.676	221.88	-0.492	-0.075					
855.073	30.002	70.016	51304.380	51734.380	14.371	227.45	-0.501	-0.076					
896.767	30.001	70.010	53806.020	54236.020	15.066	232.89	-0.510	-0.078					
938.465	30.002	70.004	56307.900	56737.900	15.761	238.20	-0.518	-0.079					
980.191	30.002	69.998	58811.460	59241.460	16.456	243.40	-0.527	-0.080					
1021.926	30.002	69.993	61315.560	61745.560	17.152	248.49	-0.534	-0.081					
1063.657	30.001	69.988	63819.420	64249.420	17.847	253.47	-0.542	-0.082					
1105.386	30.003	69.983	66323.160	66753.160	18.543	258.37	-0.549	-0.083					
1147.072	30.002	69.977	68824.320	69254.320	19.237	263.16	-0.556	-0.085					
1188.758	30.001	69.972	71325.480	71755.480	19.932	267.87	-0.564	-0.086					
1230.454	30.004	69.961	73827.240	74257.240	20.627	272.50	-0.579	-0.088					
1272.151	30.004	69.956	76329.060	76759.060	21.322	277.05	-0.587	-0.089					
1313.836	30.003	69.951	78830.160	79260.160	22.017	281.53	-0.594	-0.090					
1355.529	30.004	69.947	81331.740	81761.740	22.712	285.94	-0.600	-0.091					
1397.222	30.003	69.943	83833.320	84263.320	23.406	290.28	-0.605	-0.092					
1460.196	30.003	69.937	87611.760	88041.760	24.102	296.72	-0.614	-0.093					
1678.928	30.003	69.917	100735.680	101165.680	28.102	318.07	-0.643	-0.098					
1928.934	30.003	69.897	115736.040	116166.040	32.268	340.83	-0.671	-0.102					
2178.936	30.003	69.880	130736.160	131166.160	36.435	362.17	-0.695	-0.106					
2428.937	30.003	69.864	145736.220	146166.220	40.602	382.32	-0.718	-0.109					

Pre Exposure
Hardness
85.8

Post Desorption
Hardness
87.1

Change in
Hardness, %
1.52

Formulae Used for Analysis of Data

Uppercase letters refer to columns

Lowercase n refers to row, beginning with n=4

$Dn = (An * 60)$

$En = (Dn + M4)$

$Fh = (En / 3600)$

$Gn = SQRT(En)$

$Hn = (((Cn - L4) / L4) * 100)$

$In = ((J4 - L4) / (J4 - L4))$

$K4 = (((J4 - L4) / L4) * 100)$

$N16 = (((N12 - N8) / N8) * 100)$

Source binary TA data file : psbr143z.01

14 lines in the parameter block

3 channels of data

Run 44

Module TGA Aluminum Pans

Sample PSBR POLY(STYRENE-BUTADIENE)

Size 72.951 mg

Method DESORPTION-Isothermal

Operator BSI

Comment .339"x.041",HP@1400x50,Dry;DS-

Nsig 3

Sig1 Time (min)

Sig2 Temperature (°C)

Sig3 Weight (mg)

Kcell 1.0000

Date 22-May-00

Time 14:25

M-70.34 TG-70.369 ET: 7:10

Blank

FIGURE . CHEMICAL-MATERIAL INTERACTION DATA SET:
Supercritical Carbon Dioxide and Polyisoprene

PIP

Sorption, Desorption Diffusion, and Indentation Data Sets

Material Data

Test Reference Number:	<u>09-1-1</u>	TGA Filename:	<u>pip0131d</u>
Property Test Specification:	ASTM D471/D543		
Material Name:	<u>Polyisoprene</u>	Material Code:	<u>PIP</u>
Material Supplier:	<u>Smithers Scientific</u>	Material Class:	<u>IR</u>
Monomer Source:	<u>Dupont</u>	Base Polymer (Lot. No.):	<u>Unknown</u>
Exposure Liquid:	<u>Supercritical Carbon Dioxide</u>	Replicate Number:	<u>1</u>

Pre-Exposure Data

Measured Diameter (mm):	<u>9.81</u>	<u>9.79</u>	<u>9.85</u>	<u>9.83</u>	
Mean Diameter:	<u>9.820</u>				95% Confidence Level (CL): <u>0.041</u>
Measured Thickness (mils):	<u>41.00</u>	<u>41.00</u>	<u>41.00</u>	<u>41.00</u>	
Mean Thickness:	<u>41.000</u>				95% Confidence Level (CL): <u>0.000</u>
Initial Sample Weight (mg):	<u>83.660</u>				
Initial Durometer Hardness:	<u>66.9</u>	Scale: SHORE	<u>A</u>		

Sample Exposure Data

Exposure Date:	<u>05/10/00</u>	Time:	<u>11:06:00</u>	
Removal Date:	<u>05/10/00</u>	Time:	<u>11:21:00</u>	
Total Exposure Time (h:m:s):	<u>00:15:00</u>	Weight of Sample After Exposure (mg):	<u>86.50</u>	
Weight Gain (mg):	<u>2.84</u>	Percent Weight Gain:	<u>3.39</u>	
Final Durometer Hardness After Desorption:	<u>68.7</u>	Percent Hardness Change:	<u>2.7</u>	

Desorption Experiment

Mean Temperature of Desorption Experiment (setpoint = 30 deg C):	<u>30.001</u>	95% CL:	<u>0.0008</u>
Time Lapse Between Sample Exposure and Sample Desorption (sec):			<u>900</u>
Equilibrium Weight of Desorbed Sample at 30 deg C (mg):			<u>83.050</u>
Sample Extracted (mg):	<u>0.61</u>	Solubility Corrected for Extractables (mg):	<u>3.45</u>
Sample Extracted (%):	<u>0.73</u>	Solubility Corrected for Extractables (%):	<u>4.12</u>

Diffusion Coefficient Data: Fick's Law

High Concentration Diffusion Coefficient (cm ² /sec):	<u>8.1549E-07</u>
Range Including 0,1 Intercept, Relative Weight Fraction:	<u>1.00 - 0.30</u>
Linear Range of Desorption, Relative Weight Fraction:	<u>0.43 - 0.30</u>
Slope: <u>-1.9569E-02</u>	X-axis Intercept: <u>5.1365E+01</u>
R Square: <u>0.99817</u>	Y-axis Intercept: <u>1.0052E+00</u>
Low Concentration Diffusion Coefficient (cm ² /sec):	<u>1.2030E-10</u>
Linear Range of Desorption, Relative Weight Fraction:	<u>0.05 - 0.00</u>
Slope: <u>-2.3768E-04</u>	X-axis Intercept: <u>2.9640E+02</u>
R Square: <u>0.99247</u>	Y-axis Intercept: <u>7.0450E-02</u>

Wt. @ Zero Time, mg K 86.50	Wt. @ Zero Time, % L 3.395	Adjustment to TGA Time, sec M 900	Hardness Shore Scale N A
TGA Dry Wt., mg 83.660	Equil. Wt. Of Desorb. Sample 83.05	Min. Wt. Used For FDC, mg. 83.050	Pre Exposure Hardness 66.9
High Conc. DC, cm2/sec 8.1549E-07	Low Conc. DC, cm2/sec 1.2030E-10	Total Liquid Sorbed, mg. 2.840	Post Desorption Hardness 68.7
R Square 0.99817	R Square 0.99247		Change in Hardness, % 2.7
X Intercept 51.37	X Intercept 296.4		Mean Thickness, cm. 0.1041
Y Intercept 1.00519	Y Intercept 0.07045		
Y Intercept as Wt., mg. 86.949	X Intercept as Time, hrs. 24.4	X Intercept as Time, min. 146.4	pip0131d X Intercept as Time, days 1.0

TEMPERATURE STATISTICS

<i>Column1</i>		Max. TGA Wt., (orig data file) 84.564	TGA Wt. At 20 min. Adjustment 84.159
Mean	30.00092176	Sorption @ 7-12 min., mg	Sorption @ 20 min., mg
Standard Error	0.000420946	0.90	0.50
Median	30		
Mode	30	Sorption @ 7-12	Sorption @ 20
Standard Deviation	0.02272328	min., %	min., %
Sample Variance	0.000516347	1.08	0.60
Kurtosis	275.3486451		
Skewness	-5.327203032	Rel. Error (%) of	Rel. Error (%) of
Range	0.855	7-12 min. Sorp.	20 min. Sorp
Minimum	29.449	-68.2	-82.4
Maximum	30.304		
Sum	87422.686		
Count	2914		
Confidence Level(95.0%)	0.000825382		

DIAMETER STATISTICS

<i>Column1</i>	
Mean	9.82
Standard Error	0.01290994
Median	9.82
Mode	#N/A
Standard Deviation	0.02581989
Sample Variance	0.00066667
Kurtosis	-1.2
Skewness	-1.858E-13
Range	0.06
Minimum	9.79
Maximum	9.85
Sum	39.28
Count	4
Confidence Level(95.0%)	0.04108524

ND/value
ND/value
A/D

THICKNESS STATISTICS

<i>Column1</i>	
Mean	41
Standard Error	0
Median	41
Mode	41
Standard Deviation	0
Sample Variance	0
Kurtosis	#DIV/0!
Skewness	#DIV/0!
Range	0
Minimum	41
Maximum	41
Sum	164
Count	4
Confidence Level(95.0%)	0

Unknown
pip0131d

HIGH CONCENTRATION DIFFUSION COEFFICIENT

pip0131d

SUMMARY OUTPUT

<i>Regression Statistics</i>	
Multiple R	0.999086432
R Square	0.998173699
Adjusted R Square	0.998033214
Standard Error	0.00761116
Observations	15

ANOVA

	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	1	0.411603256	0.411603256	7105.21296	3.445E-19
Residual	13	0.000753087	5.79298E-05		
Total	14	0.412356343			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>
Intercept	1.005190268	0.007455556	134.8243179	7.7337E-22	0.989083521	1.021297014
X Variable 1	-0.019569374	0.000232161	-84.29242527	3.445E-19	-0.020070926	-0.019067821

LOW CONCENTRATION DIFFUSION COEFFICIENT

SUMMARY OUTPUT

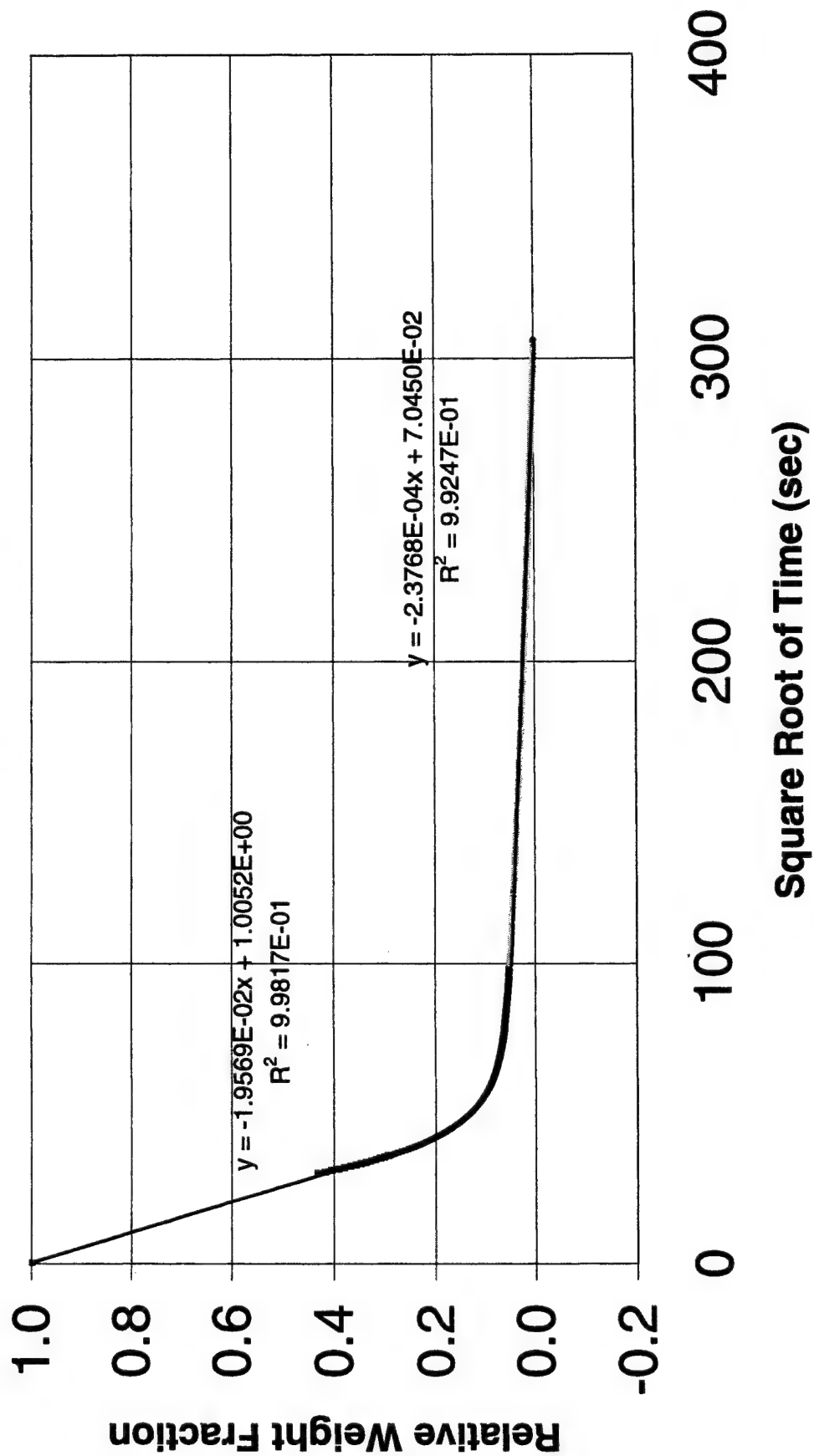
<i>Regression Statistics</i>	
Multiple R	0.996228405
R Square	0.992471035
Adjusted R Square	0.99246815
Standard Error	0.001134207
Observations	2612

ANOVA

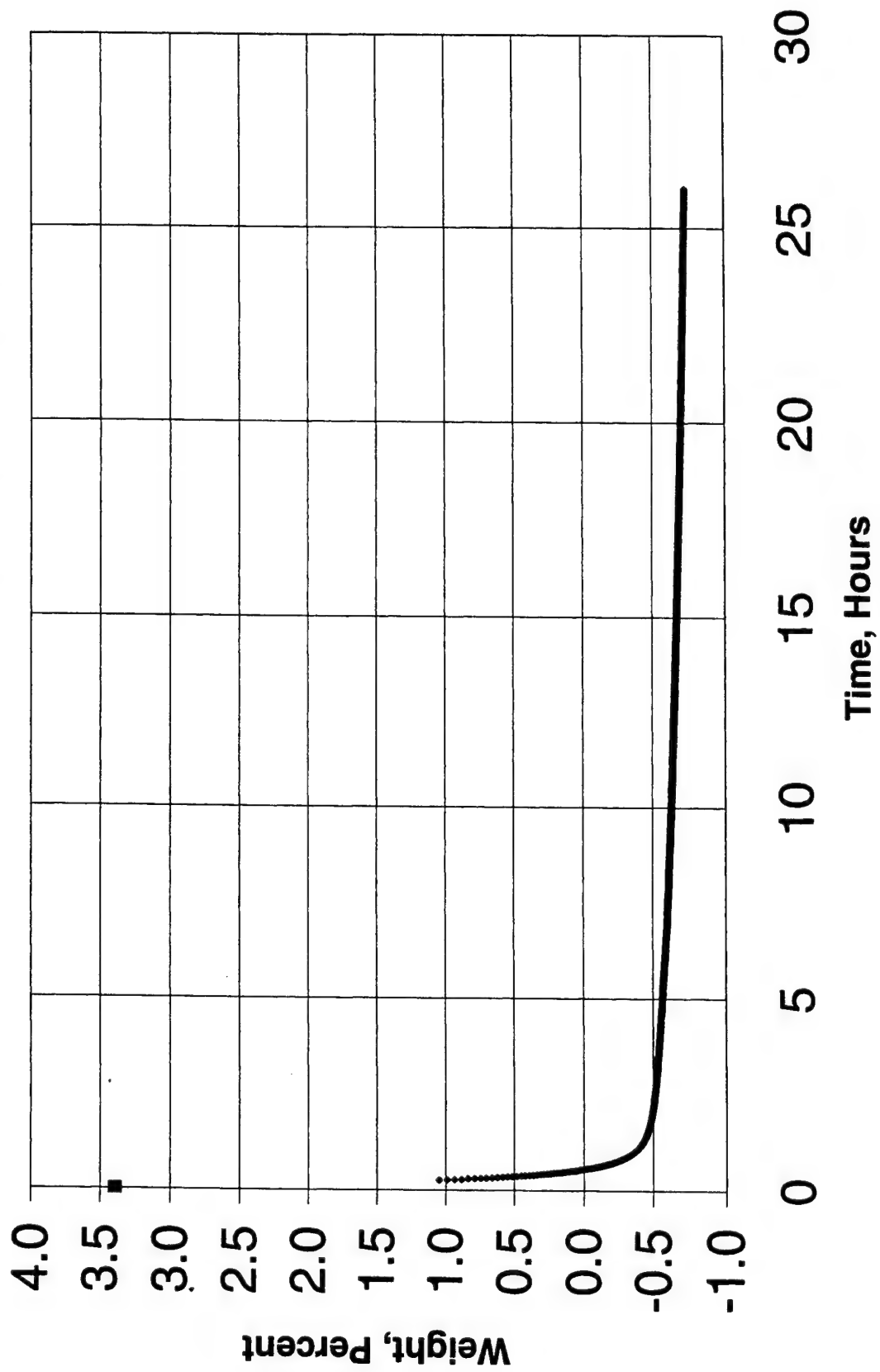
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	1	0.442596405	0.442596405	344051.2	0
Residual	2610	0.003357572	1.28643E-06		
Total	2611	0.445953977			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>
Intercept	0.070450436	8.98162E-05	784.3847471	0	0.070274318	0.070626555
X Variable 1	-0.000237683	4.05216E-07	-586.5587778	0	-0.000238478	-0.000236888

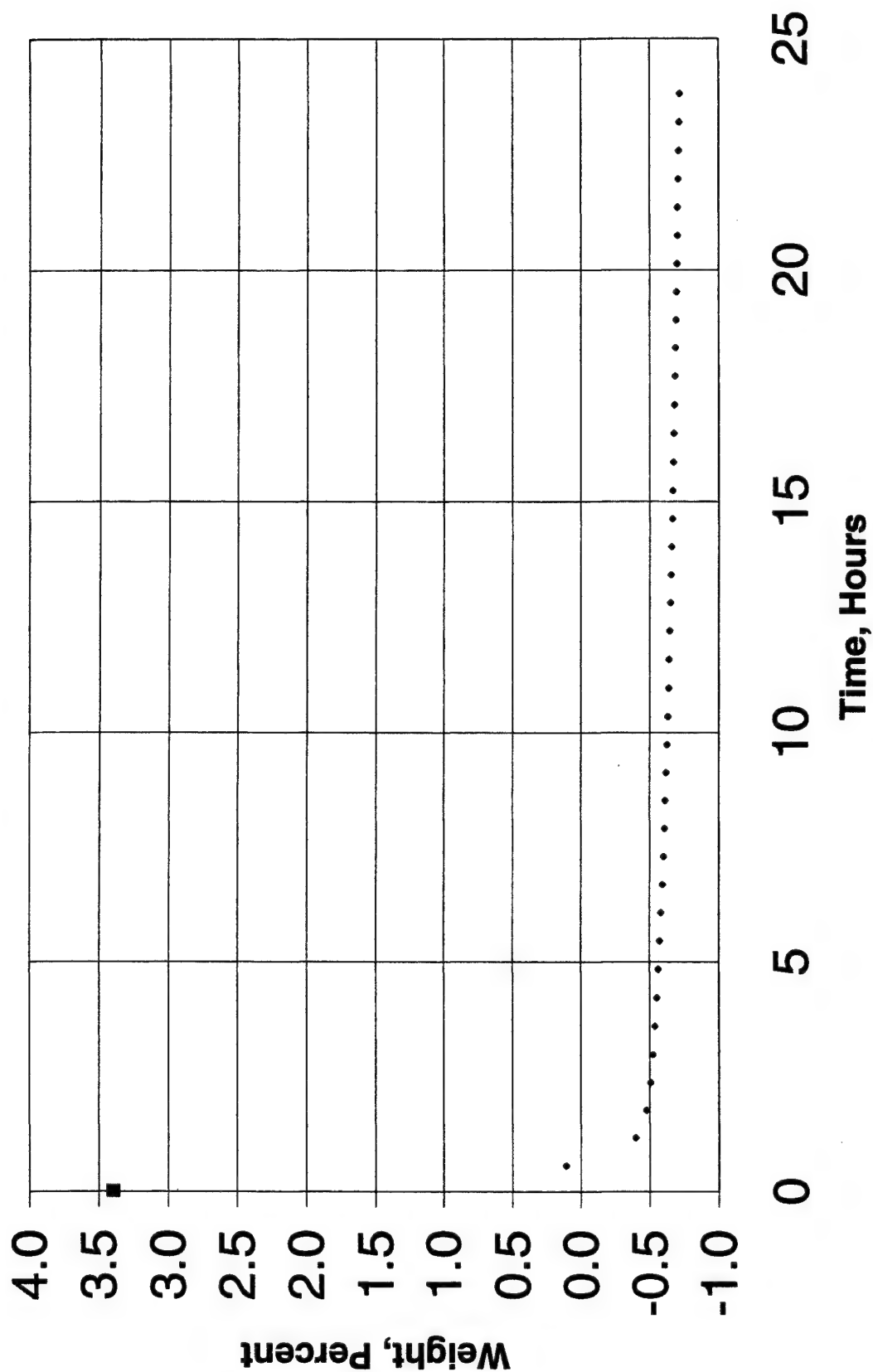
**Figure . Fick's Law Plot of Desorption Diffusion (30 degrees C)
of Supercritical Carbon Dioxide from Polymeric Materials:
PIP (0131d)**



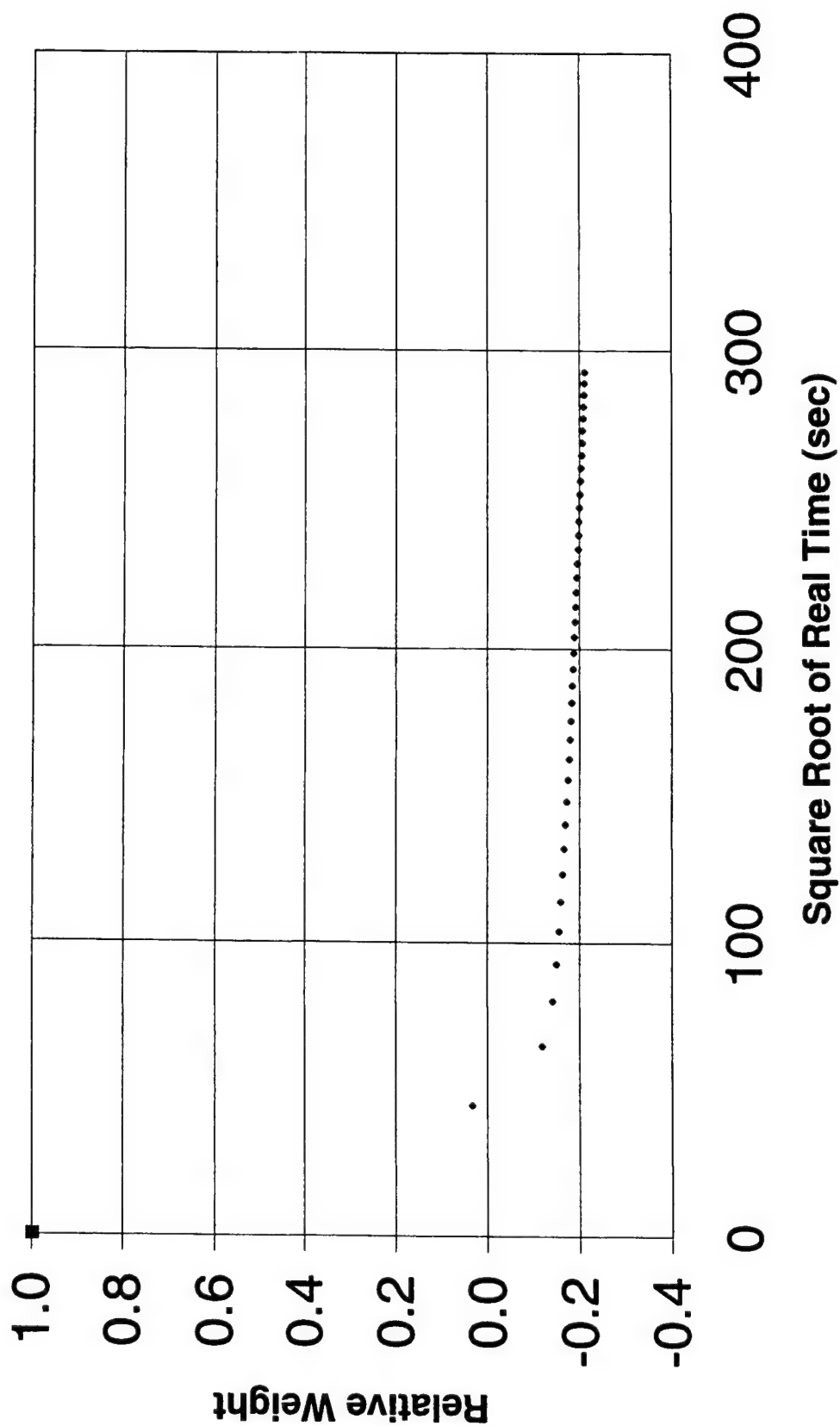
**Figure . Desorption Diffusion (30 degrees C) of Supercritical
Carbon Dioxide from Polymeric Materials: PIP (0131d)**



**Figure . Desorption Diffusion (30 degrees C) of Supercritical
Carbon Dioxide from Polymeric Materials: PIP (0131d)**



**Figure . Fick's Law Plot of Desorption Diffusion (30 degrees C) of
Supercritical Carbon Dioxide from Polymeric Materials:
PIP (0131d)**



TGA Time, min	Temp., deg C	TGA Wt., mg	TGA Time, sec	Adjusted Time, sec	Adjusted Time, hr	SQRT Adj. Time, sec	Wt. Loss, %	Fractional Wt. Loss	Wt. @ Zero Time, mg	Wt. @ Zero Time, %	TGA Dry Wt., mg	Adjustment to TGA Time, sec	Hardness Scale
A	B	C	D	E	F	G	H	I	J	K	L	M	N
18.250	30.015	83.750	1095.000	1995.000	0.554	44.67	0.110	-0.110	86.50	3.397	83.658	900	Shore A
54.918	30.000	83.324	3295.080	4195.080	1.165	64.77	-0.400	-0.118					
91.621	30.000	83.258	5497.260	6397.260	1.777	79.98	-0.478	-0.141					
128.315	30.000	83.235	7698.900	8598.900	2.389	92.73	-0.506	-0.149					
165.002	30.000	83.220	9900.120	10800.120	3.000	103.92	-0.524	-0.154					
201.757	30.000	83.208	12105.420	13005.420	3.613	114.04	-0.538	-0.158					
238.481	30.000	83.198	14308.860	15208.860	4.225	123.32	-0.550	-0.162					
275.172	30.000	83.188	16510.320	17410.320	4.836	131.95	-0.561	-0.165					
311.900	30.000	83.180	18714.000	19614.000	5.448	140.05	-0.571	-0.168					
348.605	30.004	83.172	20916.300	21816.300	6.060	147.70	-0.582	-0.171					
385.321	30.006	83.162	23119.260	24019.260	6.672	154.98	-0.592	-0.174					
422.032	30.001	83.156	25321.920	26221.920	7.284	161.93	-0.600	-0.177					
458.812	30.001	83.150	27528.720	28428.720	7.897	168.61	-0.607	-0.179					
495.545	30.001	83.146	29732.700	30632.700	8.509	175.02	-0.613	-0.180					
532.225	30.001	83.140	31933.500	32833.500	9.120	181.20	-0.619	-0.182					
568.907	30.001	83.135	34134.420	35034.420	9.732	187.17	-0.625	-0.184					
605.628	30.001	83.130	36337.680	37237.680	10.344	192.97	-0.631	-0.186					
642.341	30.001	83.126	38540.460	39440.460	10.956	198.60	-0.636	-0.187					
679.025	30.000	83.122	40741.500	41641.500	11.567	204.06	-0.641	-0.189					
715.714	30.000	83.118	42942.840	43842.840	12.179	209.39	-0.645	-0.190					
752.404	30.000	83.114	45144.240	46044.240	12.790	214.58	-0.650	-0.191					
789.094	30.001	83.111	47345.640	48245.640	13.402	219.65	-0.654	-0.193					
825.803	30.000	83.107	49548.180	50448.180	14.013	224.61	-0.659	-0.194					
862.513	30.000	83.103	51750.780	52650.780	14.625	229.46	-0.663	-0.195					
899.213	30.000	83.099	53952.780	54852.780	15.237	234.21	-0.668	-0.197					
935.920	30.000	83.096	56155.200	57055.200	15.849	238.86	-0.672	-0.198					
972.639	30.000	83.093	58358.340	59258.340	16.461	243.43	-0.676	-0.199					
1009.323	30.000	83.090	60559.380	61459.380	17.072	247.91	-0.680	-0.200					
1046.022	30.000	83.086	62761.320	63661.320	17.684	252.31	-0.684	-0.201					
1082.784	30.000	83.083	64967.040	65867.040	18.296	256.65	-0.687	-0.202					
1119.531	30.000	83.080	67171.860	68071.860	18.909	260.91	-0.691	-0.203					
1156.260	30.000	83.077	69375.600	70275.600	19.521	265.10	-0.694	-0.204					
1192.959	30.000	83.074	71577.540	72477.540	20.133	269.22	-0.699	-0.206					
1229.672	30.000	83.071	73780.320	74680.320	20.745	273.28	-0.702	-0.207					
1266.349	30.000	83.068	75980.940	76880.940	21.356	277.27	-0.705	-0.207					
1303.051	30.000	83.066	78183.060	79083.060	21.968	281.22	-0.708	-0.208					
1339.793	30.000	83.063	80387.580	81287.580	22.580	285.11	-0.712	-0.210					
1376.515	30.001	83.060	82590.900	83490.900	23.192	288.95	-0.715	-0.210					
1413.197	30.000	83.057	84791.820	85691.820	23.803	292.73	-0.718	-0.211					

Formulae Used for Analysis of Data
 Uppercase letters refer to columns
 Lowercase n refers to row, beginning with n=4

 $Dn = (An * 60)$
 $En = (Dn + M4)$
 $Fn = (En / 3600)$
 $Gn = SQRT(En)$
 $Hn = (((Cn - L4) / L4) * 100)$
 $In = ((Cn - L4) / (J4 - L4))$
 $K4 = (((J4 - L4) / L4) * 100)$
 $N16 = (((N12 - N8) / N8) * 100)$

Source binary TA data file : pip0131d.01
 14 lines in the parameter block
 3 channels of data

 Run 38
 Module TGA Aluminum Pans
 Sample PIP Mask SCO2 0131D Disk
 Size 84.564 mg
 Method DESORPTION-Isothermal
 Operator ws
 Comment .39"x.043.HP@1400x50.Dry-DS-83.5 M-83.53 TG-83.658 ET:
 Nsig 3
 Sig1 Time (min)
 Sig2 Temperature (°C)
 Sig3 Weight (mg)
 Kcell 1.0000
 Date 10-May-00
 Time 11:36

Pre Exposure
 Hardness
 66.9

Post Desorption
 Hardness
 88.7

Change in
 Hardness, %
 2.69

Blank

FIGURE . CHEMICAL-MATERIAL INTERACTION DATA SET:**Supercritical Carbon Dioxide and Polytetrafluoroethylene-propylene****TFEP****Sorption, Desorption Diffusion, and Indentation Data Sets****Material Data**

Test Reference Number:	<u>16-1-1</u>	TGA Filename:	<u>tfep153z</u>
Property Test Specification:	ASTM D471/D543		
Material Name:	<u>Polytetrafluoroethylene-propylene</u>	Material Code:	<u>TFEP</u>
Material Supplier:	<u>Smithers Scientific</u>	Material Class:	<u>FEPM</u>
Monomer Source:	<u>Xenox Corp.</u>	Base Polymer (Lot. No.):	<u>Aflas</u>
Exposure Liquid:	<u>Supercritical Carbon Dioxide</u>	Replicate Number:	<u>1</u>

Pre-Exposure Data

Measured Diameter (mm):	<u>8.48</u>	<u>8.51</u>	<u>8.57</u>	<u>8.47</u>	
Mean Diameter:	<u>8.495</u>				
Measured Thickness (mils):	<u>37.80</u>	<u>37.90</u>	<u>37.80</u>	<u>37.90</u>	95% Confidence Level (CL): <u>0.072</u>
Mean Thickness:	<u>37.850</u>				95% Confidence Level (CL): <u>0.092</u>
Initial Sample Weight (mg):	<u>86.660</u>				
Initial Durometer Hardness:	<u>91.7</u>	Scale: SHORE	<u>A</u>		

Sample Exposure Data

Exposure Date:	<u>06/01/00</u>	Time:	<u>10:51:00</u>	
Removal Date:	<u>06/01/00</u>	Time:	<u>11:06:00</u>	
Total Exposure Time (h:m:s):	<u>00:15:00</u>	Weight of Sample After Exposure (mg):	<u>88.60</u>	
Weight Gain (mg):	<u>1.94</u>	Percent Weight Gain:	<u>2.24</u>	
Final Durometer Hardness After Desorption:	<u>91.2</u>	Percent Hardness Change:	<u>-0.5</u>	

Desorption Experiment

Mean Temperature of Desorption Experiment (setpoint = 30 deg C):	<u>30.003</u>	95% CL:	<u>0.0007</u>
Time Lapse Between Sample Exposure and Sample Desorption (sec):			<u>435</u>
Equilibrium Weight of Desorbed Sample at 30 deg C (mg):			<u>86.530</u>
Sample Extracted (mg):	<u>0.13</u>	Solubility Corrected for Extractables (mg):	<u>2.07</u>
Sample Extracted (%):	<u>0.15</u>	Solubility Corrected for Extractables (%):	<u>2.39</u>

Diffusion Coefficient Data: Fick's Law

High Concentration Diffusion Coefficient (cm ² /sec):	<u>2.2477E-07</u>
Range Including 0,1 Intercept, Relative Weight Fraction:	<u>1.00 - 0.60</u>
Linear Range of Desorption, Relative Weight Fraction:	<u>0.76 - 0.60</u>
Slope:	<u>-1.1129E-02</u>
X-axis Intercept:	<u>8.9797E+01</u>
R Square:	<u>0.99997</u>
Y-axis Intercept:	<u>9.9935E-01</u>

Low Concentration Diffusion Coefficient (cm ² /sec):	<u>1.5448E-10</u>
Linear Range of Desorption, Relative Weight Fraction:	<u>0.03 - 0.00</u>
Slope:	<u>-2.9175E-04</u>
X-axis Intercept:	<u>2.8372E+02</u>
R Square:	<u>0.94893</u>
Y-axis Intercept:	<u>8.2775E-02</u>

Wt. @ Zero Time, mg K 88.60	Wt. @ Zero Time, % L 2.239	Adjustment to TGA Time, sec M 435	Hardness Shore Scale N A
TGA Dry Wt., mg 86.660	Equil. Wt. Of Desorb. Sample 86.53	Min. Wt. Used For FDC, mg. 86.530	Pre Exposure Hardness 91.7
High Conc. DC, cm2/sec 2.2477E-07	Low Conc. DC, cm2/sec 1.5448E-10	Total Liquid Sorbed, mg. 1.940	Post Desorption Hardness 91.2
R Square 0.99997	R Square 0.94893		Change in Hardness, % -0.5
X Intercept 89.80	X Intercept 283.7		Mean Thickness, cm. 0.0961
Y Intercept 0.99935	Y Intercept 0.08277		
Y Intercept as Wt., mg. 88.543	X Intercept as Time, hrs. 22.4	X Intercept as Time, min. 134.2	tfep153z X Intercept as Time, days 0.9

TEMPERATURE STATISTICS

<i>Column1</i>		Max. TGA Wt., (orig data file) 88.120	TGA Wt. At 20 min. Adjustment 87.799
Mean	30.00324974	Sorption @ 7-12 min., mg	Sorption @ 20 min., mg
Standard Error	0.000377758	1.46	1.14
Median	30.004		
Mode	30.004	Sorption @ 7-12	Sorption @ 20
Standard Deviation	0.020381461	min., %	min., %
Sample Variance	0.000415404	1.68	1.31
Kurtosis	744.542963		
Skewness	-21.7623114	Rel. Error (%) of	Rel. Error (%) of
Range	0.926	7-12 min. Sorp.	20 min. Sorp
Minimum	29.253	-24.7	-41.3
Maximum	30.179		
Sum	87339.46		
Count	2911		
Confidence Level(95.0%)	0.000740701		

DIAMETER STATISTICS

<i>Column1</i>	
Mean	8.5075
Standard Error	0.0225
Median	8.495
Mode	#N/A
Standard Deviation	0.045
Sample Variance	0.002025
Kurtosis	0.97607072
Skewness	1.24828532
Range	0.1
Minimum	8.47
Maximum	8.57
Sum	34.03
Count	4
Confidence Level(95.0%)	0.07160511

ND/value
ND/value
A/D

THICKNESS STATISTICS

<i>Column1</i>	
Mean	37.85
Standard Error	0.02886751
Median	37.85
Mode	37.8
Standard Deviation	0.05773503
Sample Variance	0.00333333
Kurtosis	-6
Skewness	3.6904E-13
Range	0.1
Minimum	37.8
Maximum	37.9
Sum	151.4
Count	4
Confidence Level(95.0%)	0.0918694

Aflas
tfep153z

HIGH CONCENTRATION DIFFUSION COEFFICIENT

tfep153z

SUMMARY OUTPUT

<i>Regression Statistics</i>	
Multiple R	0.999987226
R Square	0.999974453
Adjusted R Square	0.999973572
Standard Error	0.000396
Observations	31

ANOVA

	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	1	0.178008399	0.178008399	1135139.85	3.74453E-68
Residual	29	4.54767E-06	1.56816E-07		
Total	30	0.178012946			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>
Intercept	0.999351506	0.000304914	3277.48683	2.6367E-82	0.998727887	0.999975125
X Variable 1	-0.01112896	1.04455E-05	-1065.42942	3.7445E-68	-0.011150323	-0.011107596

LOW CONCENTRATION DIFFUSION COEFFICIENT

SUMMARY OUTPUT

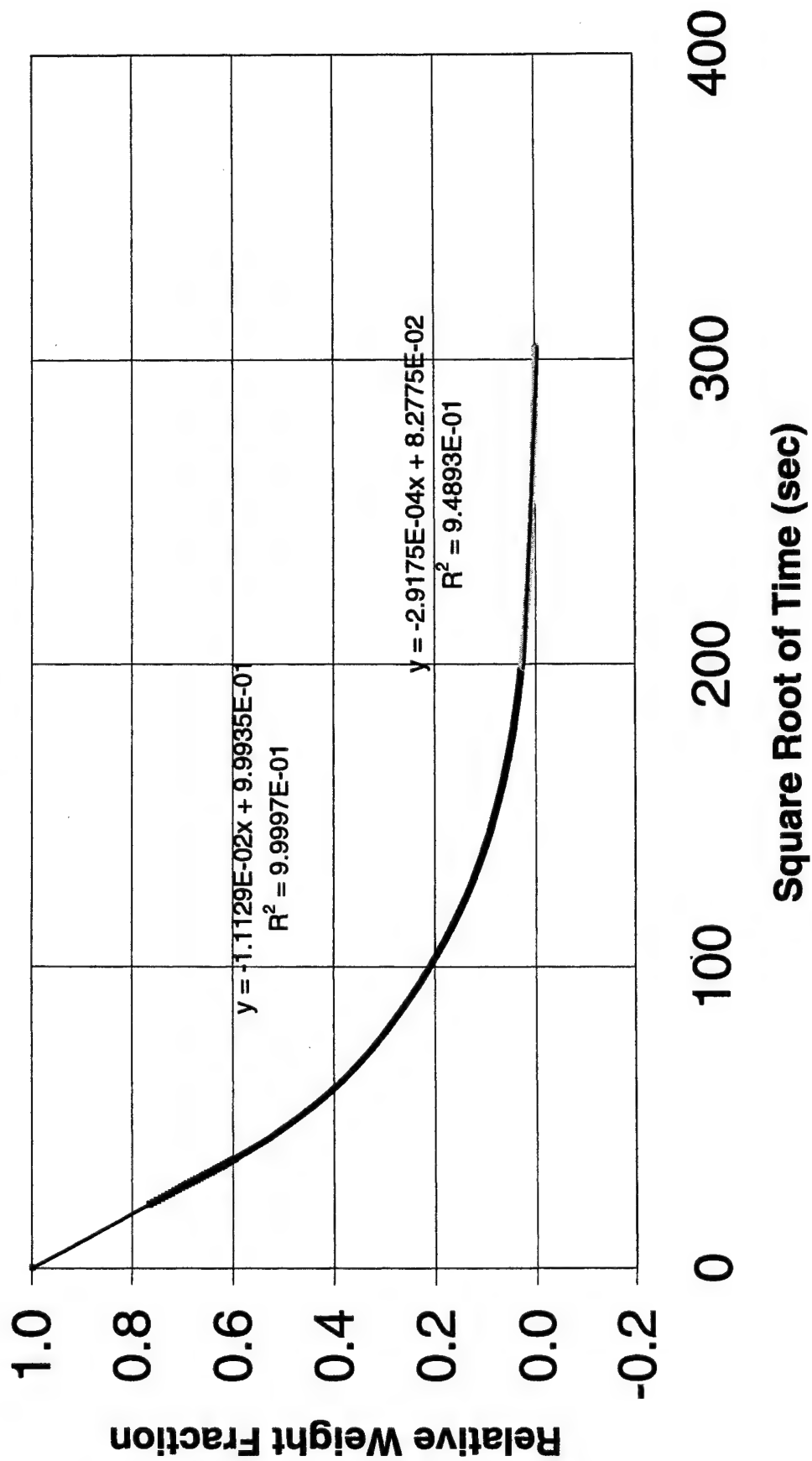
<i>Regression Statistics</i>	
Multiple R	0.974128452
R Square	0.948926241
Adjusted R Square	0.948894538
Standard Error	0.001909407
Observations	1613

ANOVA

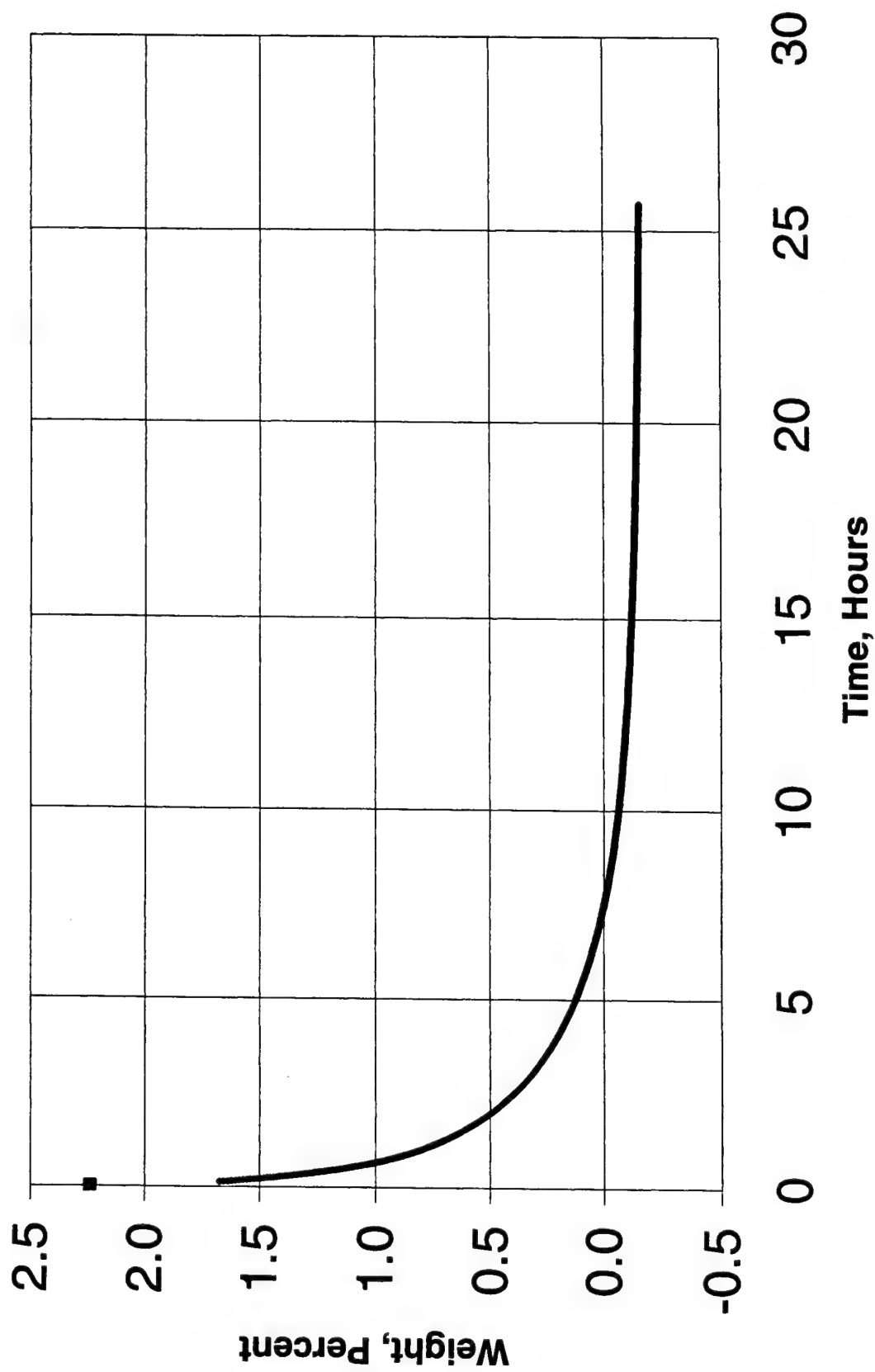
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	1	0.109125722	0.109125722	29931.6165	0
Residual	1611	0.005873439	3.64583E-06		
Total	1612	0.114999162			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>
Intercept	0.082774917	0.000425528	194.5228466	0	0.08194027	0.083609564
X Variable 1	-0.000291753	1.68636E-06	-173.007562	0	-0.00029506	-0.000288445

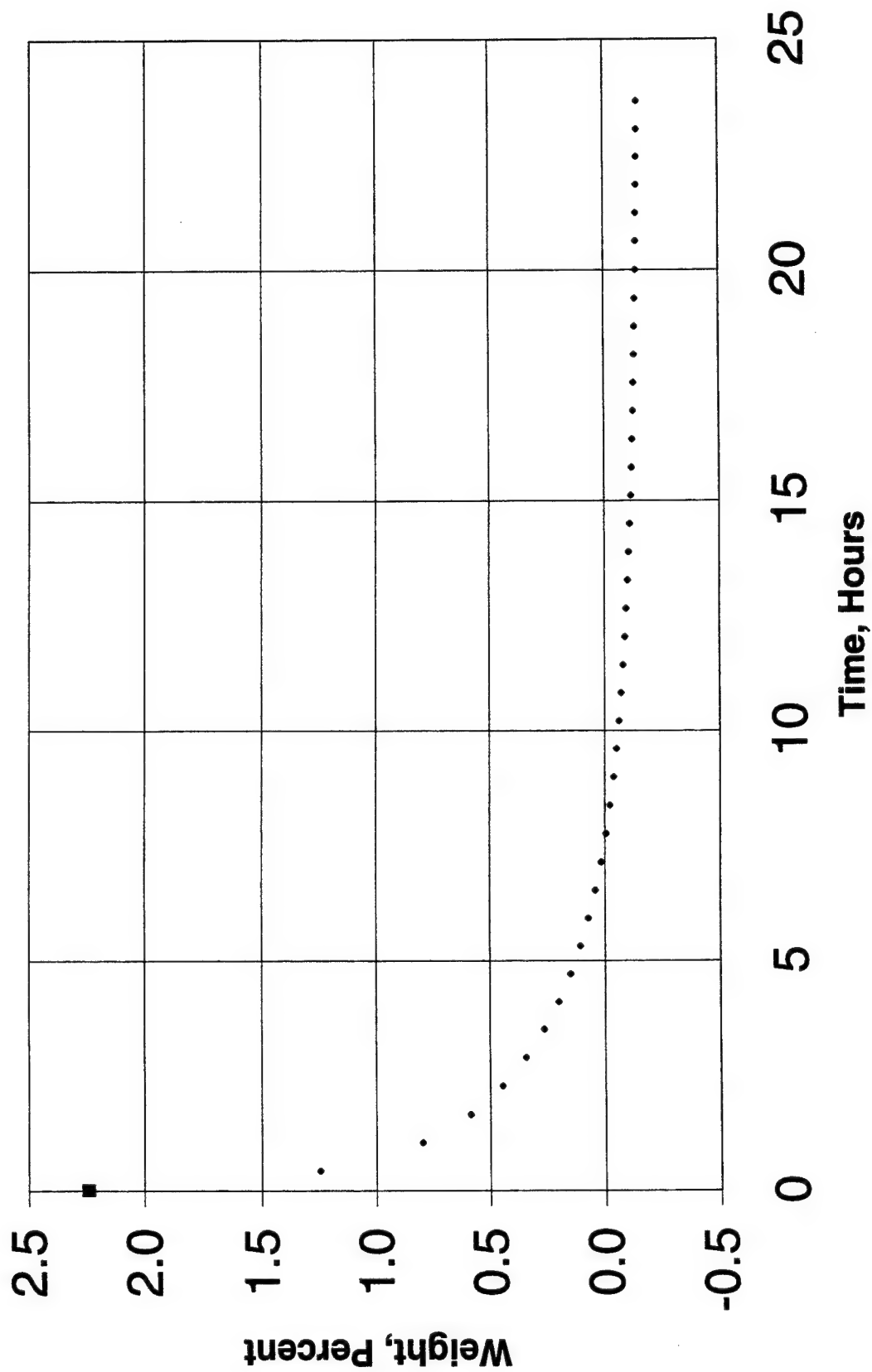
**Figure . Fick's Law Plot of Desorption Diffusion (30 degrees C)
of Supercritical Carbon Dioxide from Polymeric Materials:
TFEP (153z)**



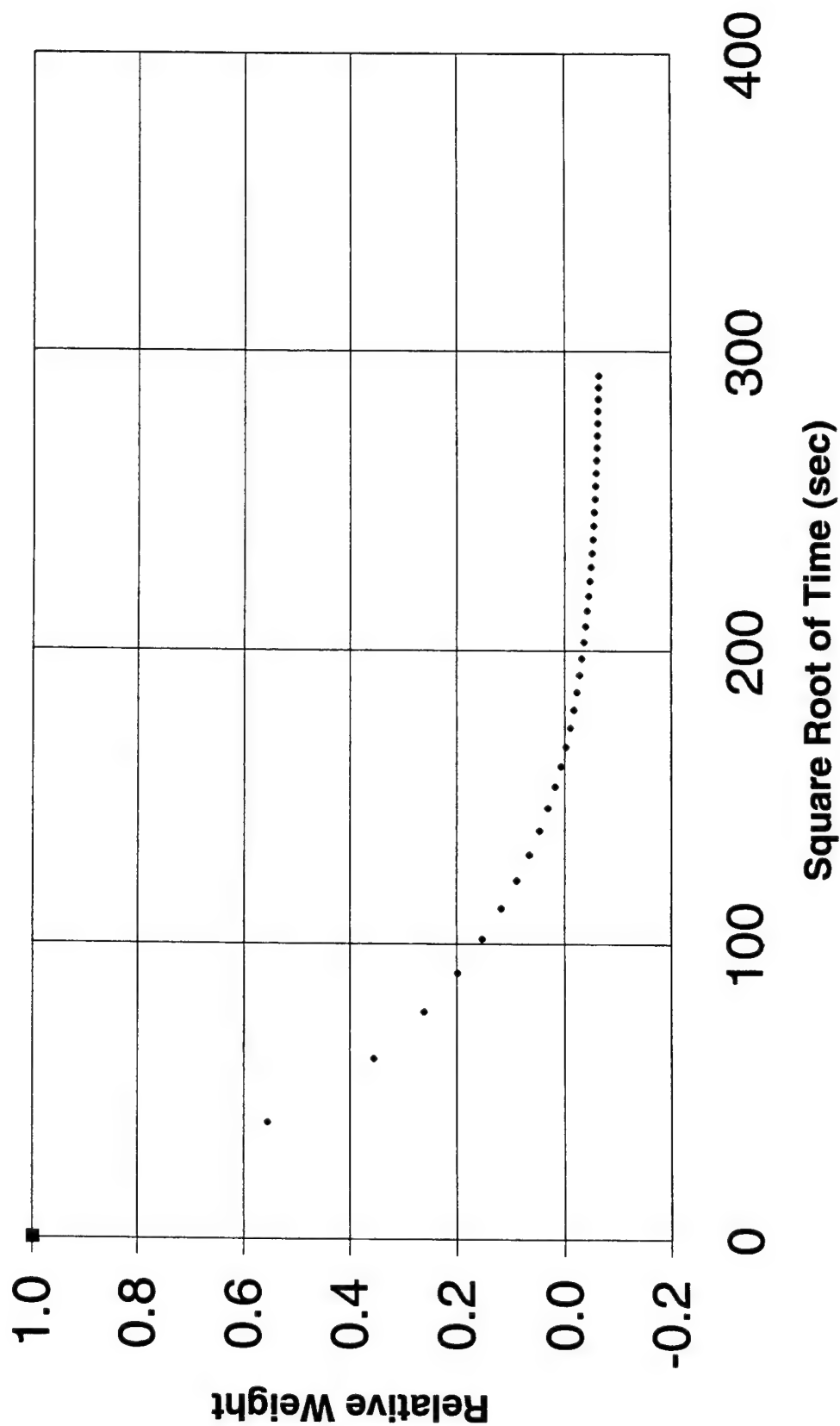
**Figure . Desorption Diffusion (30 degrees C) of Supercritical
Carbon Dioxide from Polymeric Materials: TFEF (153z)**



**Figure . Desorption Diffusion (30 degrees C) of Supercritical
Carbon Dioxide from Polymeric Materials: TFEF (153z)**



**Figure . Fick's Law Plot of Desorption Diffusion (30 degrees C) of
Supercritical Carbon Dioxide from Polymeric Materials:
TFEP (153z)**



TGA Time, min	Temp., deg C	TGA Wt., mg	TGA Time, sec	Adjusted Time, sec	Adjusted Time, hr	SQRT Adj. Time, sec	Wt. Loss, %	Fractional Wt. Loss	Wt. @ Zero Time, mg	Wt. @ Zero Time, %	TGA Dry Wt., mg	Adjustment to TGA Time, sec	Hardness Scale
A	B	C	D	E	F	G	H	I	J	K	L	M	N
18.267	29.995	87.735	1096.020	1531.020	0.425	39.13	1.243	0.555	88.60	2.242	86.657	435	Shore A
54.949	30.004	87.347	3296.940	3731.940	1.037	61.09	0.796	0.355					
91.643	30.003	87.164	5498.580	5933.580	1.648	77.03	0.585	0.261					
128.327	30.002	87.043	7699.620	8134.620	2.260	90.19	0.445	0.199					
165.015	30.003	86.954	9900.900	10335.900	2.871	101.67	0.342	0.153					Pre Exposure Hardness 91.7
201.762	30.002	86.885	12105.720	12540.720	3.484	111.99	0.263	0.117					
238.467	30.001	86.830	14308.020	14743.020	4.095	121.42	0.200	0.089					
275.211	30.001	86.785	16512.660	16947.660	4.708	130.18	0.148	0.066					Post Desorption Hardness 91.2
311.908	30.002	86.749	18714.480	19149.480	5.319	138.38	0.106	0.047					
348.584	30.001	86.718	20915.040	21350.040	5.931	146.12	0.071	0.032					
385.271	30.001	86.693	23116.260	23551.260	6.542	153.46	0.041	0.018					
421.962	30.004	86.671	25317.720	25752.720	7.154	160.48	0.017	0.007					
458.655	30.004	86.653	27519.300	27954.300	7.765	167.20	-0.005	-0.002					Change in Hardness, % -0.55
495.388	30.004	86.637	29723.280	30158.280	8.377	173.66	-0.023	-0.010					
532.135	30.004	86.624	31928.100	32363.100	8.990	179.90	-0.038	-0.017					
568.842	30.004	86.613	34130.520	34565.520	9.602	185.92	-0.051	-0.023					
605.566	30.003	86.603	36333.960	36768.960	10.214	191.75	-0.063	-0.028					
642.297	30.004	86.595	38537.820	38972.820	10.826	197.42	-0.072	-0.032					
679.006	30.003	86.587	40740.360	41175.360	11.438	202.92	-0.081	-0.036					
715.693	30.005	86.580	42941.580	43376.580	12.049	208.27	-0.088	-0.039					
752.418	30.005	86.575	45145.080	45580.080	12.661	213.49	-0.095	-0.042					
789.111	30.005	86.569	47346.660	47781.660	13.273	218.59	-0.101	-0.045					
825.795	30.006	86.565	49547.700	49982.700	13.884	223.57	-0.107	-0.048					
862.505	30.006	86.561	51750.300	52185.300	14.496	228.44	-0.111	-0.050					
899.183	30.006	86.557	53950.980	54385.980	15.107	233.21	-0.116	-0.052					
935.875	30.005	86.554	56152.500	56587.500	15.719	237.88	-0.119	-0.053					
972.554	30.005	86.551	58353.240	58788.240	16.330	242.46	-0.123	-0.055					
1009.234	30.005	86.548	60554.040	60989.040	16.941	246.96	-0.126	-0.056					
1045.921	30.006	86.546	62755.260	63190.260	17.553	251.38	-0.129	-0.057					
1082.634	30.006	86.543	64958.040	65393.040	18.165	255.72	-0.131	-0.059					
1119.315	30.004	86.541	67158.900	67593.900	18.776	259.99	-0.134	-0.060					
1155.990	30.004	86.539	69359.400	69794.400	19.387	264.19	-0.136	-0.061					
1192.685	30.004	86.538	71561.100	71996.100	19.999	268.32	-0.138	-0.062					
1229.411	30.004	86.536	73764.660	74199.660	20.611	272.40	-0.140	-0.062					
1266.099	30.004	86.535	75965.940	76400.940	21.222	276.41	-0.141	-0.063					
1302.805	30.002	86.533	78168.300	78603.300	21.834	280.36	-0.143	-0.064					
1339.546	30.003	86.532	80372.760	80807.760	22.447	284.27	-0.144	-0.064					
1376.260	30.001	86.531	82575.600	83010.600	23.059	288.12	-0.145	-0.065					
1412.963	30.001	86.530	84777.780	85212.780	23.670	291.91	-0.146	-0.065					

Source binary TA data file : tfep153z.01

14 lines in the parameter block

3 channels of data

Run 47

Module TGA Aluminum Pans

Sample TFEF Poly(TFE/P) Atlas 0153Z

Size 88.120 mg

Method DESORPTION-Isothermal

Operator bsi

Comment .34"x.040", HP15@1400 Dry: M-86.80 TGA-86.657 ET: 7:15

Nsig 3

Sig1 Time (min)

Sig2 Temperature (°C)

Sig3 Weight (mg)

Kcell 1.0000

Date 1-Jun-00

Time 11:14

Blank

FIGURE . CHEMICAL-MATERIAL INTERACTION DATA SET:**Supercritical Carbon Dioxide and Polyetheretherketone****PEEK****Sorption, Desorption Diffusion, and Indentation Data Sets****Material Data**

Test Reference Number:	<u>17-1-1</u>	TGA Filename:	<u>peek154z</u>
Property Test Specification:	ASTM D471/D543		
Material Name:	<u>Polyetheretherketone</u>	Material Code:	<u>PEEK</u>
Material Supplier:	<u>Goodfellow Cambridge Ltd.</u>	Material Class:	<u>Blank</u>
Monomer Source:	<u>Unknown</u>	Base Polymer (Lot. No.):	<u>Unknown</u>
Exposure Liquid:	<u>Supercritical Carbon Dioxide</u>	Replicate Number:	<u>1</u>

Pre-Exposure Data

Measured Diameter (mm):	<u>8.52</u>	<u>8.39</u>	<u>8.51</u>	<u>8.49</u>	
Mean Diameter:	<u>8.500</u>				
Measured Thickness (mils):	<u>19.40</u>	<u>20.60</u>	<u>20.60</u>	<u>18.10</u>	
Mean Thickness:	<u>19.675</u>				
Initial Sample Weight (mg):	<u>31.620</u>				
Initial Durometer Hardness:	<u>76.4</u>	Scale: SHORE	<u>D</u>		
				95% Confidence Level (CL):	<u>0.095</u>
				95% Confidence Level (CL):	<u>1.898</u>

Sample Exposure Data

Exposure Date:	<u>06/02/00</u>	Time:	<u>13:16:00</u>		
Removal Date:	<u>06/02/00</u>	Time:	<u>13:31:00</u>		
Total Exposure Time (h:m:s):	<u>00:15:00</u>	Weight of Sample After Exposure (mg):	<u>32.00</u>		
Weight Gain (mg):	<u>0.38</u>	Percent Weight Gain:	<u>1.20</u>		
Final Durometer Hardness After Desorption:	<u>77.0</u>	Percent Hardness Change:	<u>0.8</u>		

Desorption Experiment

Mean Temperature of Desorption Experiment (setpoint = 30 deg C):	<u>30.001</u>	95% CL:	<u>0.0008</u>
Time Lapse Between Sample Exposure and Sample Desorption (sec):			<u>460</u>
Equilibrium Weight of Desorbed Sample at 30 deg C (mg):			<u>31.530</u>
Sample Extracted (mg):	<u>0.09</u>	Solubility Corrected for Extractables (mg):	<u>0.47</u>
Sample Extracted (%):	<u>0.28</u>	Solubility Corrected for Extractables (%):	<u>1.49</u>

Diffusion Coefficient Data: Fick's Law

High Concentration Diffusion Coefficient (cm ² /sec):	<u>7.9890E-08</u>
Range Including 0,1 Intercept, Relative Weight Fraction:	<u>1.00 - 0.65</u>
Linear Range of Desorption, Relative Weight Fraction:	<u>0.71 - 0.65</u>
Slope:	<u>-1.2764E-02</u>
X-axis Intercept:	<u>7.8057E+01</u>
R Square:	<u>0.99756</u>
Y-axis Intercept:	<u>9.9631E-01</u>

Low Concentration Diffusion Coefficient (cm ² /sec):	<u>9.4139E-11</u>
Linear Range of Desorption, Relative Weight Fraction:	<u>0.05 - 0.00</u>
Slope:	<u>-4.3815E-04</u>
X-axis Intercept:	<u>3.7315E+02</u>
R Square:	<u>0.99517</u>
Y-axis Intercept:	<u>1.6349E-01</u>

Wt. @ Zero Time, mg K 32.00	Wt. @ Zero Time, % L 1.202	Adjustment to TGA Time, sec M 460	Hardness Shore Scale N D
TGA Dry Wt., mg 31.620	Equil. Wt. Of Desorb. Sample 31.53	Min. Wt. Used For FDC, mg. 31.530	Pre Exposure Hardness 76.4
High Conc. DC, cm2/sec 7.9890E-08	Low Conc. DC, cm2/sec 9.4139E-11	Total Liquid Sorbed, mg. 0.380	Post Desorption Hardness 77.0
R Square 0.99756	R Square 0.99517		Change in Hardness, % 0.8
X Intercept 78.06	X Intercept 373.1		Mean Thickness, cm. 0.0500
Y Intercept 0.99631	Y Intercept 0.16349		
Y Intercept as Wt., mg. 31.882	X Intercept as Time, hrs. 38.7	X Intercept as Time, min. 232.1	peek154z X Intercept as Time, days 1.6

TEMPERATURE STATISTICS

<i>Column1</i>		Max. TGA Wt., (orig data file) 31.868	TGA Wt. At 20 min. Adjustment 31.809
Mean	30.00087581	Sorption @ 7-12 min., mg	Sorption @ 20 min., mg
Standard Error	0.000430896	0.25	0.19
Median	30.001		
Mode	29.999	Sorption @ 7-12 min., %	Sorption @ 20 min., %
Standard Deviation	0.024576198	0.78	0.60
Sample Variance	0.000603989		
Kurtosis	697.3108555	Rel. Error (%) of 7-12 min. Sorp.	Rel. Error (%) of 20 min. Sorp
Skewness	-20.17012678	-34.7	-50.3
Range	1.14		
Minimum	29.096		
Maximum	30.236		
Sum	97592.849		
Count	3253		
Confidence Level(95.0%)	0.000844855		

DIAMETER STATISTICS

<i>Column1</i>	
Mean	8.4775
Standard Error	0.02982588
Median	8.5
Mode	#N/A
Standard Deviation	0.05965177
Sample Variance	0.00355833
Kurtosis	3.09087419
Skewness	-1.749027
Range	0.13
Minimum	8.39
Maximum	8.52
ND/value	Sum 33.91
ND/value	Count 4
A/D	Confidence Level(95.0%) 0.09491936

THICKNESS STATISTICS

<i>Column1</i>	
Mean	19.675
Standard Error	0.59634302
Median	20
Mode	20.6
Standard Deviation	1.19268604
Sample Variance	1.4225
Kurtosis	-0.941917
Unknown	Skewness -0.9214039
peek154z	Range 2.5
	Minimum 18.1
	Maximum 20.6
	Sum 78.7
	Count 4
	Confidence Level(95.0%) 1.89783143

HIGH CONCENTRATION DIFFUSION COEFFICIENT

peek154z

SUMMARY OUTPUT

<i>Regression Statistics</i>	
Multiple R	0.998781593
R Square	0.997564671
Adjusted R Square	0.997321138
Standard Error	0.004906673
Observations	12

ANOVA

	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	1	0.098618322	0.098618322	4096.22143	2.11023E-14
Residual	10	0.000240754	2.40754E-05		
Total	11	0.098859077			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>
Intercept	0.996311686	0.004754227	209.5633309	1.5049E-19	0.985718606	1.006904766
X Variable 1	-0.01276392	0.000199431	-64.00172992	2.1102E-14	-0.01320828	-0.012319561

LOW CONCENTRATION DIFFUSION COEFFICIENT

SUMMARY OUTPUT

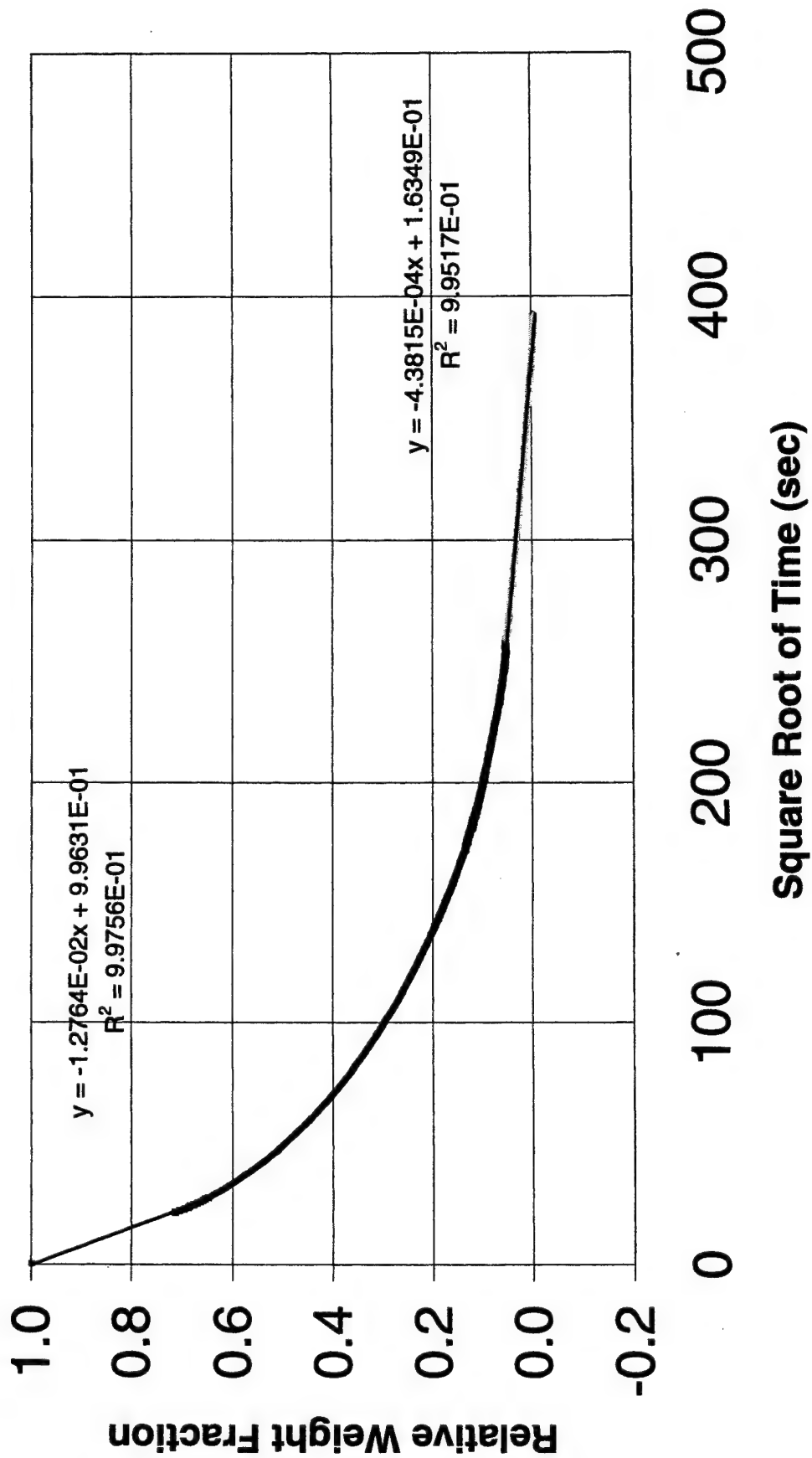
<i>Regression Statistics</i>	
Multiple R	0.997584511
R Square	0.995174856
Adjusted R Square	0.995170221
Standard Error	0.001161622
Observations	1043

ANOVA

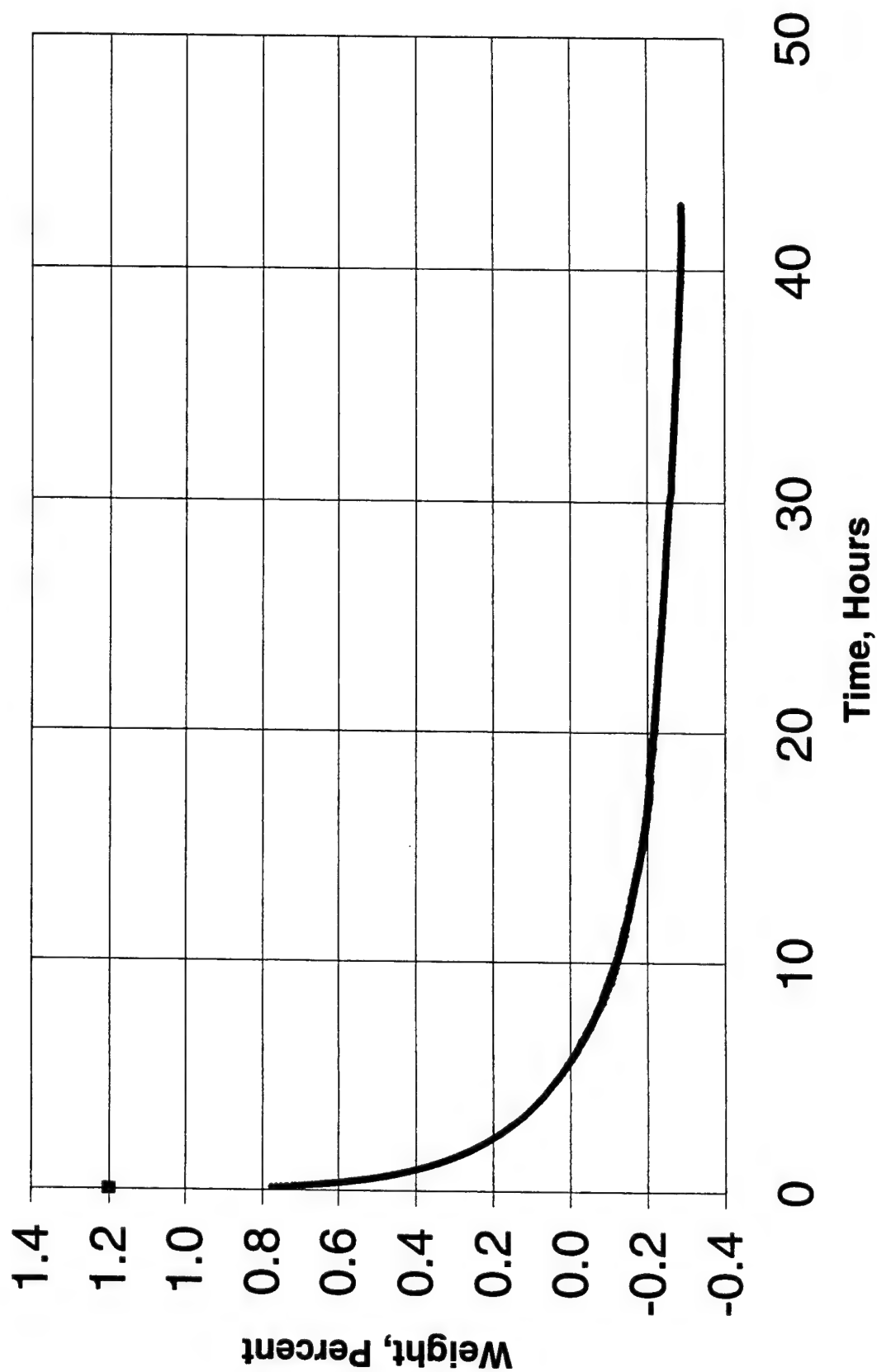
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	1	0.28971378	0.28971378	214703.867	0
Residual	1041	0.001404688	1.34936E-06		
Total	1042	0.291118469			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>
Intercept	0.16349385	0.000287599	568.4775202	0	0.162929509	0.16405819
X Variable 1	-0.000438149	9.45589E-07	-463.3614866	0	-0.000440005	-0.000436294

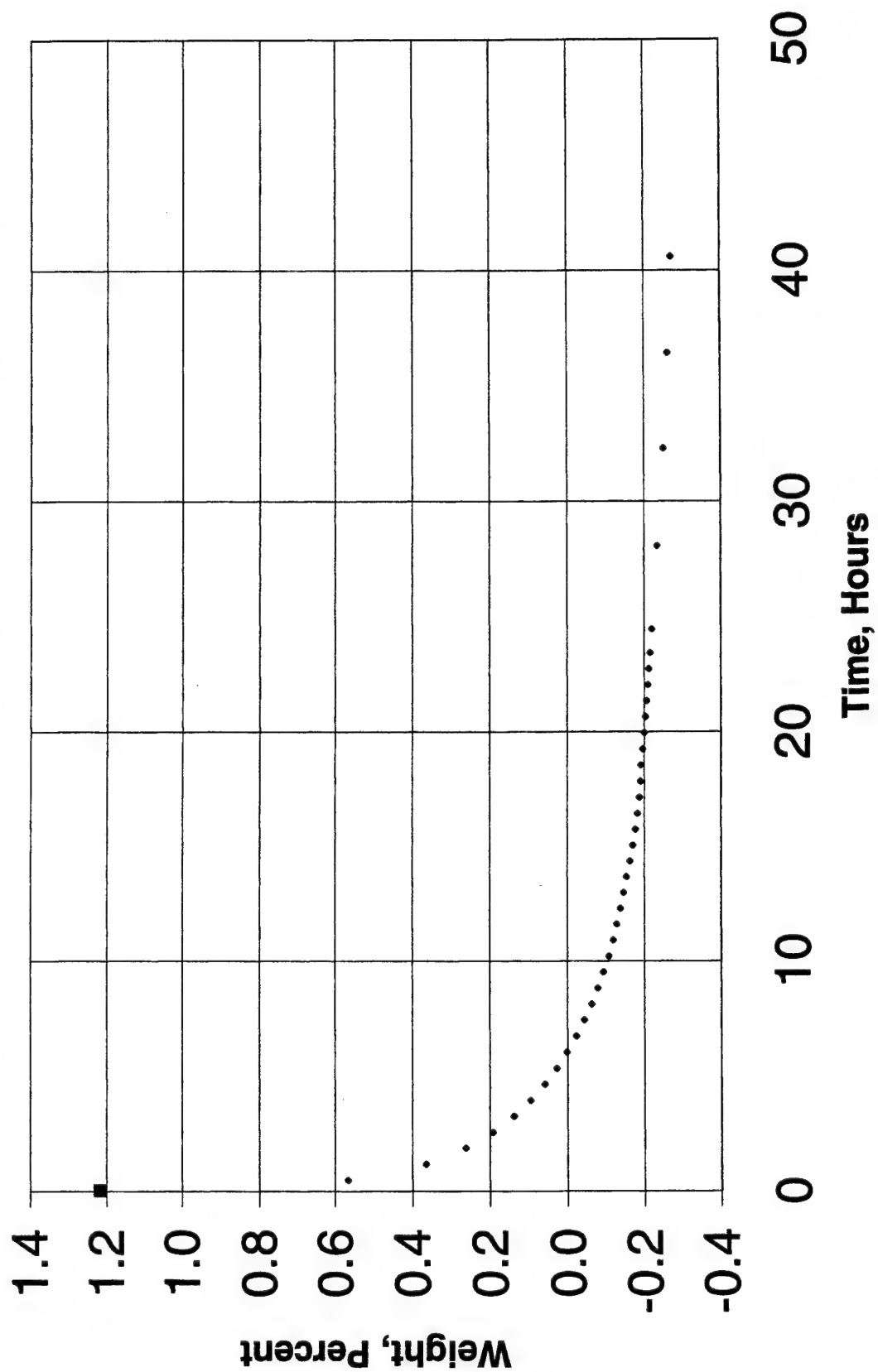
**Figure . Fick's Law Plot of Desorption Diffusion (30 degrees C)
of Supercritical Carbon Dioxide from Polymeric Materials:
PEEK (154z)**



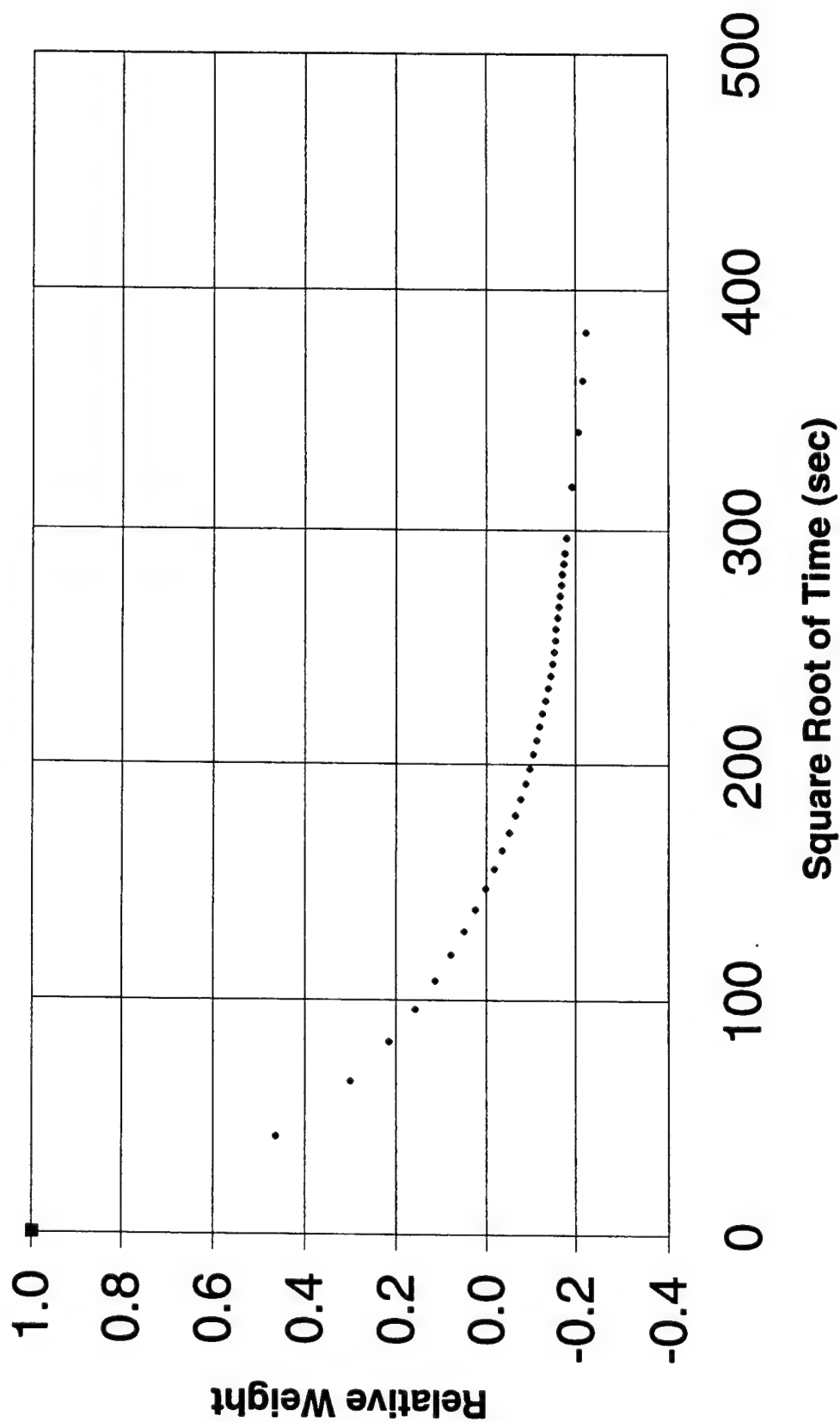
**Figure . Desorption Diffusion (30 degrees C) of Supercritical
Carbon Dioxide from Polymeric Materials: PEEK (154z)**



**Figure . Desorption Diffusion (30 degrees C) of Supercritical
Carbon Dioxide from Polymeric Materials: PEEK (154z)**



**Figure . Fick's Law Plot of Desorption Diffusion (30 degrees C) of
Supercritical Carbon Dioxide from Polymeric Materials:
PEEK (154z)**



TGA Time, min	Temp., deg C	TGA Wt., mg	TGA Time, sec	Adjusted Time, sec	Adjusted Time, hr	SQRT Adj. Time, sec	Wt. Loss, %	Fractional Wt. Loss	Wt. @ Zero Time, mg	Wt. @ Zero Time, %	TGA Dry Wt., mg	Adjustment to TGA Time, sec	Hardness Scale
A	B	C	D	E	F	G	H	I	J	K	L	M	N
20.766	29.991	31.794	1245.960	1705.960	0.474	41.30	0.566	0.465	32.00	1.218	31.615	460	Shore D
62.465	30.000	31.730	3747.900	4207.900	1.169	64.87	0.365	0.300					
104.143	30.000	31.698	6248.580	6708.580	1.863	81.91	0.263	0.216					
145.887	30.000	31.676	8753.220	9213.220	2.559	95.99	0.193	0.158					
187.603	30.000	31.659	11256.180	11716.180	3.254	108.24	0.139	0.114					
229.349	30.001	31.645	13760.940	14220.940	3.950	119.25	0.096	0.079					
271.066	30.000	31.634	16263.960	16723.960	4.646	129.32	0.060	0.049					
312.757	30.001	31.624	18765.420	19225.420	5.340	138.66	0.029	0.024					
354.506	30.001	31.616	21270.360	21730.360	6.036	147.41	0.002	0.002					
396.227	30.000	31.608	23773.620	24233.620	6.732	155.67	-0.022	-0.018					
437.952	30.001	31.601	26277.120	26737.120	7.427	163.51	-0.043	-0.036					
479.678	30.001	31.595	28780.680	29240.680	8.122	171.00	-0.063	-0.052					
521.376	30.000	31.590	31282.560	31742.560	8.817	178.16	-0.079	-0.065					
563.065	30.001	31.585	33783.900	34243.900	9.512	185.05	-0.094	-0.077					
604.761	30.001	31.581	36285.660	36745.660	10.207	191.69	-0.108	-0.088					
646.458	30.002	31.578	38787.480	39247.480	10.902	198.11	-0.119	-0.097					
688.136	30.000	31.575	41288.160	41748.160	11.597	204.32	-0.128	-0.105					
729.818	30.001	31.571	43789.080	44249.080	12.291	210.35	-0.138	-0.113					
771.536	30.002	31.569	46292.160	46752.160	12.987	216.22	-0.146	-0.120					
813.236	30.003	31.566	48794.160	49254.160	13.682	221.93	-0.154	-0.126					
854.920	30.002	31.564	51295.200	51755.200	14.376	227.50	-0.163	-0.134					
896.635	30.001	31.561	53798.100	54258.100	15.072	232.93	-0.170	-0.140					
938.362	30.002	31.559	56301.720	56761.720	15.767	238.25	-0.177	-0.145					
980.082	30.001	31.557	58804.920	59264.920	16.462	243.44	-0.182	-0.150					
1021.799	30.002	31.556	61307.940	61767.940	17.158	248.53	-0.187	-0.154					
1063.517	30.002	31.555	63811.020	64271.020	17.853	253.52	-0.190	-0.156					
1105.202	30.002	31.555	66312.120	66772.120	18.548	258.40	-0.191	-0.157					
1146.919	30.002	31.553	68815.140	69275.140	19.243	263.20	-0.196	-0.161					
1188.665	30.002	31.552	71319.900	71779.900	19.939	267.92	-0.200	-0.164					
1230.382	30.000	31.551	73822.920	74282.920	20.634	272.55	-0.203	-0.167					
1272.100	30.001	31.550	76326.000	76786.000	21.329	277.10	-0.206	-0.169					
1313.792	30.001	31.549	78827.520	79287.520	22.024	281.58	-0.209	-0.172					
1355.506	30.000	31.548	81330.360	81790.360	22.720	285.99	-0.212	-0.174					
1397.207	30.002	31.547	83832.420	84292.420	23.415	290.33	-0.215	-0.177					
1459.442	30.001	31.546	87566.520	88026.520	24.152	296.69	-0.220	-0.181					
1677.259	30.001	31.541	100635.540	101095.540	28.082	317.96	-0.234	-0.192					
1927.273	30.002	31.536	115636.380	116096.380	32.249	340.73	-0.251	-0.206					
2177.282	30.001	31.532	130636.920	131096.920	36.416	362.07	-0.262	-0.215					
2427.304	30.002	31.529	145638.240	146098.240	40.583	382.23	-0.272	-0.223					

Formulae Used for Analysis of Data

Uppercase letters refer to columns

Lowercase n refers to row, beginning with n=4

 $Dn = (An * 60)$ $En = (Dn + M4)$ $Fh = (En / 3600)$ $Gn = SQRT(En)$ $Hn = (((Cn - L4) / L4) * 100)$ $In = ((Cn - L4) / (J4 - L4))$ $K4 = (((J4 - L4) / L4) * 100)$ $N16 = (((N12 - N8) / N8) * 100)$

Source binary TA data file : peek154z.01

14 lines in the parameter block

3 channels of data

Run 48

Module TGA Aluminum Pans

Sample PEEK SCO2 0154Z

Size 31.868 mg

Method DESORPTION-Isothermal

Operator bsi

Comment .334"x.020", HP15@1400 Dry: M-31.62 TGA-31.615 ET: 7.40

Nsig 3

Sig1 Time (min)

Sig2 Temperature (°C)

Sig3 Weight (mg)

Kcell 1.0000

Date 2-Jun-00

Time 13:39

Pre Exposure

Hardness

76.4

Post Desorption

Hardness

77.0

Change in

Hardness, %

0.79

Blank

FIGURE . CHEMICAL-MATERIAL INTERACTION DATA SET:**Supercritical Carbon Dioxide and Polydimethylsiloxane****PDMS****Sorption, Desorption Diffusion, and Indentation Data Sets****Material Data**

Test Reference Number:	<u>12-1-2</u>	TGA Filename:	<u>pdms139d</u>
Property Test Specification:	ASTM D471/D543		
Material Name:	<u>Polydimethylsiloxane</u>	Material Code:	<u>PDMS</u>
Material Supplier:	<u>Smithers Scientific</u>	Material Class:	<u>MQ</u>
Monomer Source:	<u>Mine Safety, GE</u>	Base Polymer (Lot. No.):	<u>Silicone 306017B</u>
Exposure Liquid:	<u>Supercritical Carbon Dioxide</u>	Replicate Number:	<u>2</u>

Pre-Exposure Data

Measured Diameter (mm):	<u>8.50</u>	<u>8.53</u>	<u>8.46</u>	<u>8.53</u>	
Mean Diameter:	<u>8.515</u>				95% Confidence Level (CL): <u>0.053</u>
Measured Thickness (mils):	<u>46.40</u>	<u>46.60</u>	<u>46.90</u>	<u>47.90</u>	
Mean Thickness:	<u>46.950</u>				95% Confidence Level (CL): <u>1.059</u>
Initial Sample Weight (mg):	<u>77.560</u>				
Initial Durometer Hardness:	<u>63.9</u>	Scale: SHORE	<u>A</u>		

Sample Exposure Data

Exposure Date:	<u>05/18/00</u>	Time:	<u>13:45:00</u>	
Removal Date:	<u>05/18/00</u>	Time:	<u>14:00:00</u>	
Total Exposure Time (h:m:s):	<u>00:15:00</u>	Weight of Sample After Exposure (mg):	<u>77.90</u>	
Weight Gain (mg):	<u>0.34</u>	Percent Weight Gain:	<u>0.44</u>	
Final Durometer Hardness After Desorption:	<u>64.9</u>	Percent Hardness Change:	<u>1.6</u>	

Desorption Experiment

Mean Temperature of Desorption Experiment (setpoint = 30 deg C):	<u>29.999</u>	95% CL:	<u>0.0016</u>
Time Lapse Between Sample Exposure and Sample Desorption (sec):			<u>495</u>
Equilibrium Weight of Desorbed Sample at 30 deg C (mg):			<u>77.580</u>
Sample Extracted (mg):	<u>-0.02</u>	Solubility Corrected for Extractables (mg):	<u>0.34</u>
Sample Extracted (%):	<u>-0.03</u>	Solubility Corrected for Extractables (%):	<u>0.44</u>

Diffusion Coefficient Data: Fick's Law

High Concentration Diffusion Coefficient (cm ² /sec):	<u>2.9977E-06</u>
Range Including 0,1 Intercept, Relative Weight Fraction:	<u>1.00 - 0.20</u>
Linear Range of Desorption, Relative Weight Fraction:	<u>0.27 - 0.20</u>
Slope:	<u>-3.2765E-02</u>
X-axis Intercept:	<u>3.0531E+01</u>
R Square:	<u>0.99985</u>
Y-axis Intercept:	<u>1.0004E+00</u>
Low Concentration Diffusion Coefficient (cm ² /sec):	<u>1.1404E-10</u>
Linear Range of Desorption, Relative Weight Fraction:	<u>0.10 - 0.07</u>
Slope:	<u>-2.0209E-04</u>
X-axis Intercept:	<u>5.4657E+02</u>
R Square:	<u>0.95730</u>
Y-axis Intercept:	<u>1.1046E-01</u>

Wt. @ Zero Time, mg K 77.90	Wt. @ Zero Time, % L 0.438	Adjustment to TGA Time, sec M 495	Hardness Shore Scale N A
TGA Dry Wt., mg 77.560	Equil. Wt. Of Desorb. Sample 77.58	Min. Wt. Used For FDC, mg. 77.560	Pre Exposure Hardness 63.9
High Conc. DC, cm2/sec 2.9977E-06	Low Conc. DC, cm2/sec 1.1404E-10	Total Liquid Sorbed, mg. 0.340	Post Desorption Hardness 64.9
R Square 0.99985	R Square 0.95730		Change in Hardness, % 1.6
X Intercept 30.53	X Intercept 546.6		Mean Thickness, cm. 0.1193
Y Intercept 1.00036	Y Intercept 0.11046		
Y Intercept as Wt., mg. 77.928	X Intercept as Time, hrs. 83.0	X Intercept as Time, min. 497.9	pdms139d X Intercept as Time, days 3.5

TEMPERATURE STATISTICS

Column1		Max. TGA Wt., (orig data file) 77.661	TGA Wt. At 20 min. Adjustment 77.605
Mean	29.99932403	Sorption @ 7-12 min., mg	Sorption @ 20 min., mg
Standard Error	0.000810539	0.10	0.05
Median	30		
Mode	30.001	Sorption @ 7-12 min., %	Sorption @ 20 min., %
Standard Deviation	0.030305911	0.13	0.06
Sample Variance	0.000918448		
Kurtosis	473.3664074		
Skewness	-19.01879488	Rel. Error (%) of 7-12 min. Sorp.	Rel. Error (%) of 20 min. Sorp
Range	0.988	-70.3	-86.8
Minimum	29.164		
Maximum	30.152		
Sum	41939.055		
Count	1398		
Confidence Level(95.0%)	0.001590003		

DIAMETER STATISTICS

<i>Column1</i>	
Mean	8.505
Standard Error	0.01658312
Median	8.515
Mode	8.53
Standard Deviation	0.03316625
Sample Variance	0.0011
Kurtosis	-0.0495868
Skewness	-1.0964049
Range	0.07
Minimum	8.46
Maximum	8.53
Sum	34.02
Count	4
Confidence Level(95.0%)	0.05277495

THICKNESS STATISTICS

<i>Column1</i>	
Mean	46.95
Standard Error	0.33291641
Median	46.75
Mode	#N/A
Standard Deviation	0.66583281
Sample Variance	0.44333333
Kurtosis	2.12030075
Skewness	1.46348464
Range	1.5
Minimum	46.4
Maximum	47.9
Sum	187.8
Count	4
Confidence Level(95.0%)	1.05948958

HIGH CONCENTRATION DIFFUSION COEFFICIENT

pdms139d

SUMMARY OUTPUT

<i>Regression Statistics</i>	
Multiple R	0.999922767
R Square	0.99984554
Adjusted R Square	0.999794054
Standard Error	0.004940927
Observations	5

ANOVA

	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	1	0.474084097	0.474084097	19419.5215	8.14765E-07
Residual	3	7.32383E-05	2.44128E-05		
Total	4	0.474157336			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>
Intercept	1.000357561	0.004931748	202.840359	2.6422E-07	0.984662523	1.016052599
X Variable 1	-0.032764957	0.00023512	-139.3539432	8.1477E-07	-0.033513216	-0.032016698

LOW CONCENTRATION DIFFUSION COEFFICIENT

SUMMARY OUTPUT

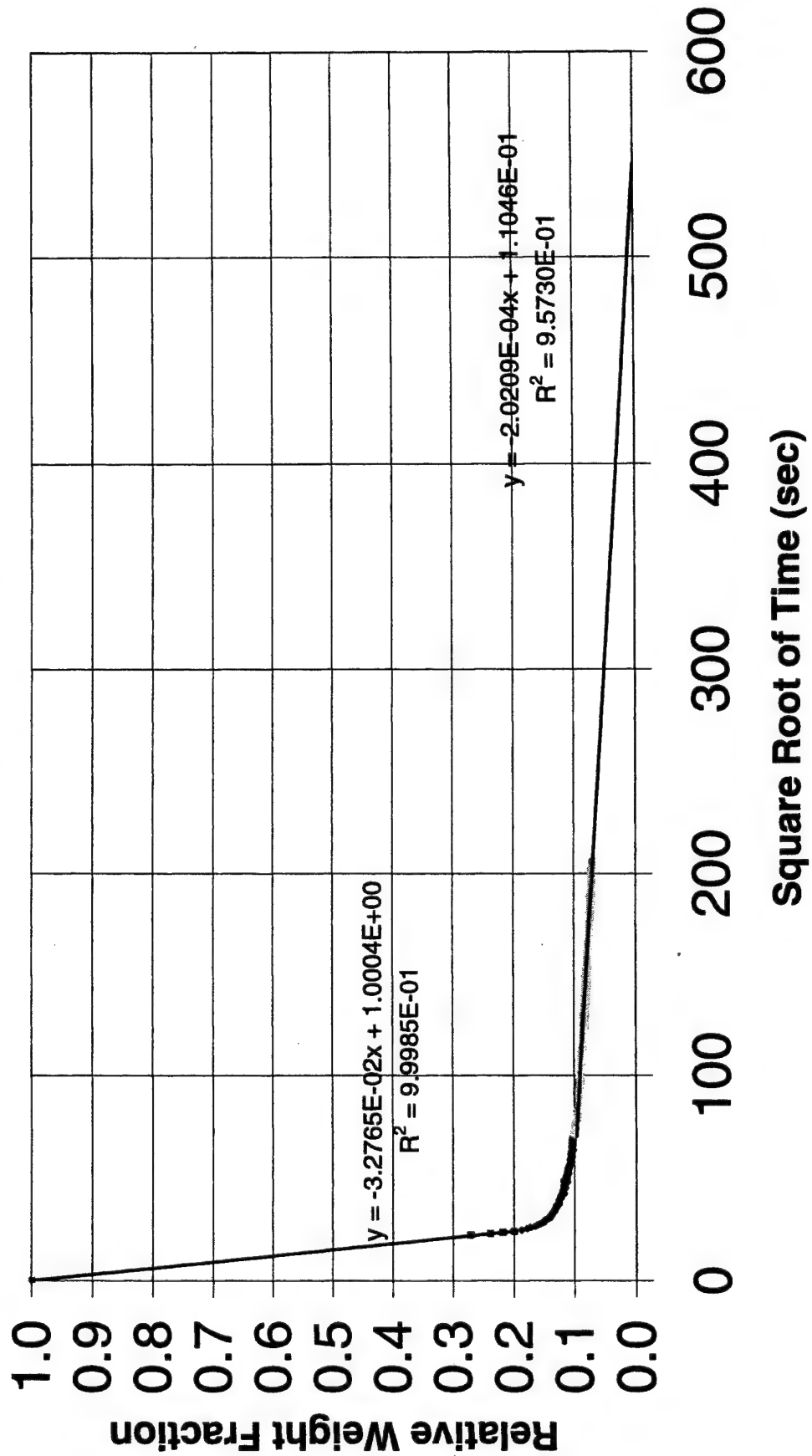
<i>Regression Statistics</i>	
Multiple R	0.978415444
R Square	0.957296781
Adjusted R Square	0.957262591
Standard Error	0.001608951
Observations	1251

ANOVA

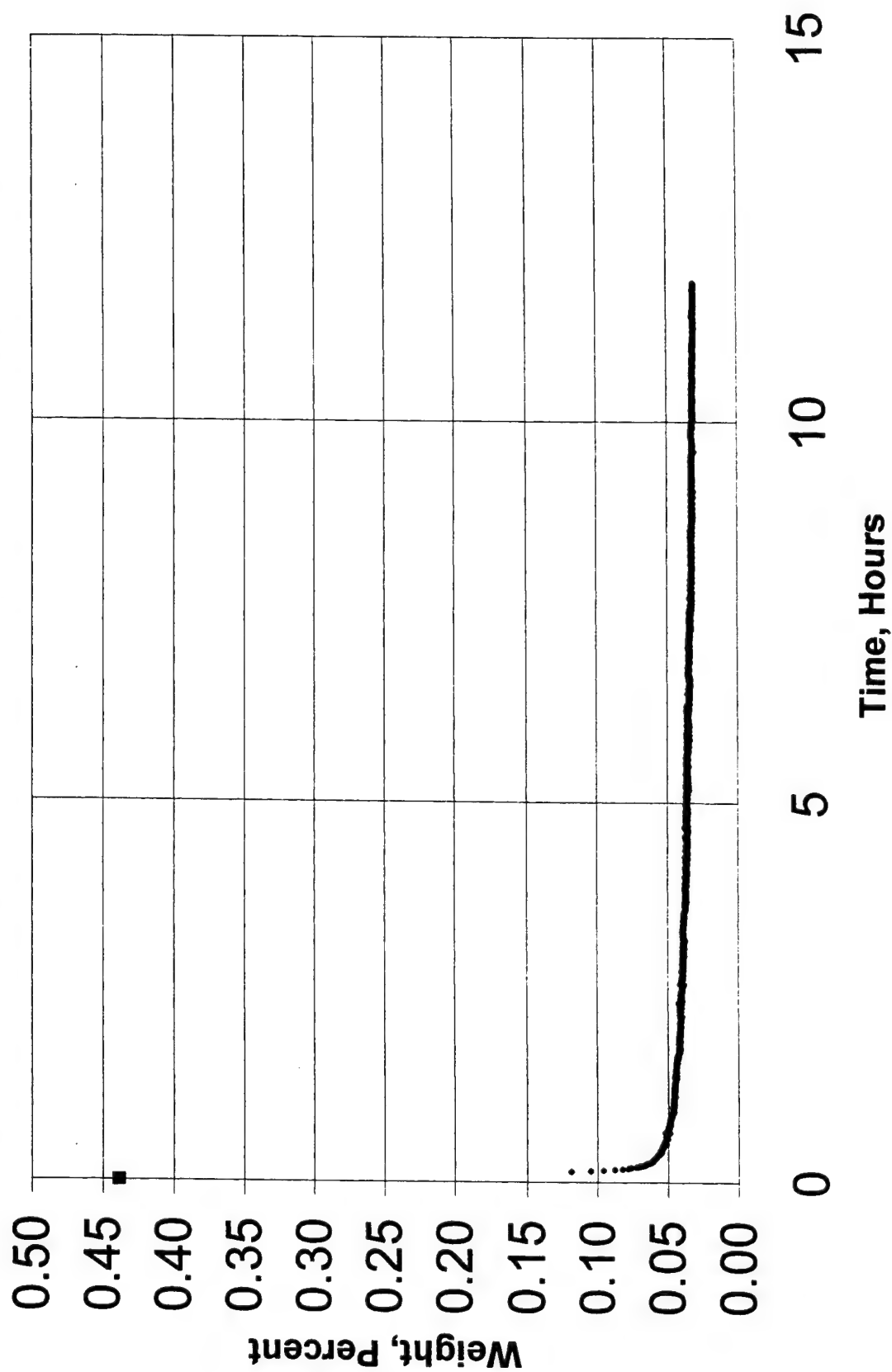
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	1	0.072482686	0.072482686	27999.3805	0
Residual	1249	0.003233317	2.58872E-06		
Total	1250	0.075716003			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>
Intercept	0.110456779	0.000185908	594.1465439	0	0.110092052	0.110821507
X Variable 1	-0.000202092	1.20774E-06	-167.3301541	0	-0.000204461	-0.000199722

**Figure . Fick's Law Plot of Desorption Diffusion (30 degrees C)
of Supercritical Carbon Dioxide from Polymeric Materials:
PDMS (139d)**



**Figure . Desorption Diffusion (30 degrees C) of Supercritical
Carbon Dioxide from Polymeric Materials: PDMS (139d)**



**Figure . Desorption Diffusion (30 degrees C) of Supercritical
Carbon Dioxide from Polymeric Materials: PDMS (139d)**

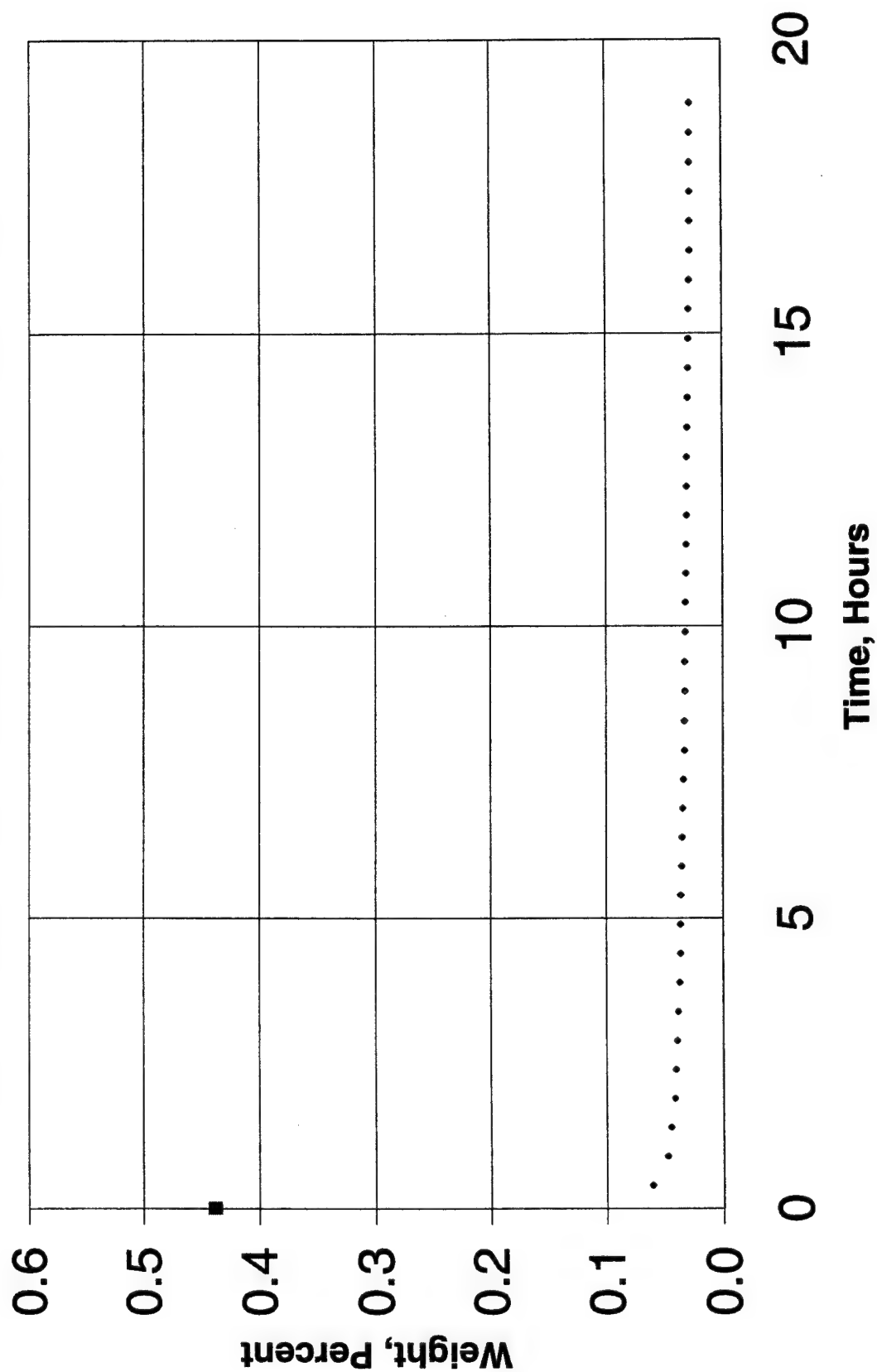
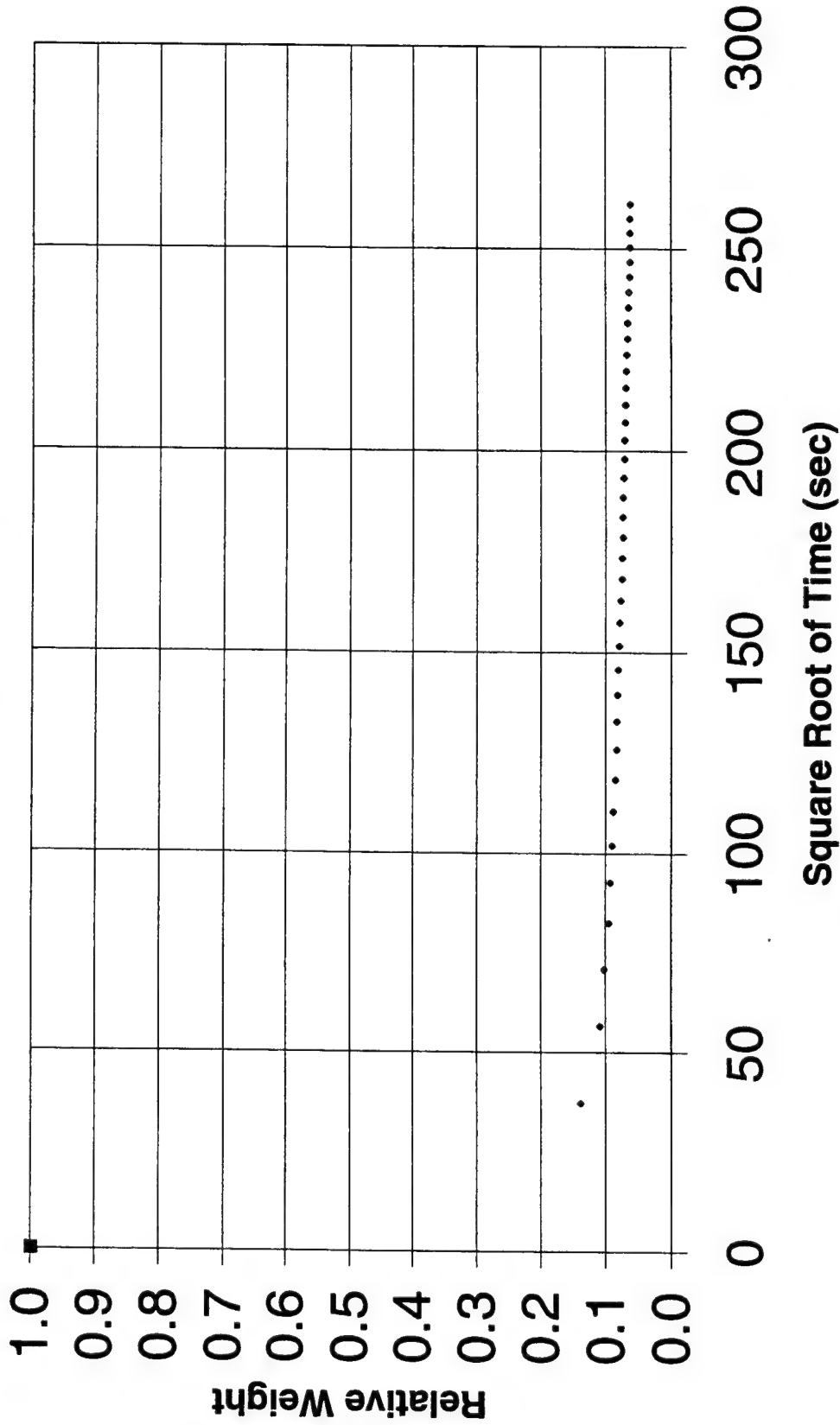


Figure . Fick's Law Plot of Desorption Diffusion (30 degrees C) of Supercritical Carbon Dioxide from Polymeric Materials: PDMS (139d)



TGA Time, min	Temp., deg C	TGA Wt., mg	TGA Time, sec	Adjusted Time, sec	Adjusted Time, hr	SQRT Adj. Time, sec	Wt. Loss, %	Fractional Wt. Loss	Wt. @ Zero Time, mg	Wt. @ Zero Time, %	TGA Dry Wt., mg	Adjustment to TGA Time, sec	Hardness Scale
A	B	C	D	E	F	G	H	I	J	K	L	M	N
14.919	29.979	77.607	895.140	1390.140	0.386	37.28	0.061	0.138	77.90	0.438	77.56	495	Shore A
44.935	30.000	77.597	2696.100	3191.100	0.886	56.49	0.048	0.109					
74.985	30.000	77.595	4499.100	4994.100	1.387	70.67	0.045	0.102					
105.009	30.001	77.592	6300.540	6795.540	1.888	82.44	0.042	0.095					
135.030	30.000	77.592	8101.800	8596.800	2.388	92.72	0.041	0.093					
165.083	30.000	77.591	9904.980	10399.980	2.889	101.98	0.039	0.090					
195.115	30.000	77.590	11706.900	12201.900	3.389	110.46	0.039	0.088					
225.215	30.000	77.589	13512.900	14007.900	3.891	118.35	0.037	0.085					
255.230	30.000	77.588	15313.800	15808.800	4.391	125.73	0.036	0.083					
285.285	30.001	77.588	17117.100	17612.100	4.892	132.71	0.036	0.083					
315.345	30.000	77.588	18920.700	19415.700	5.393	139.34	0.036	0.082					
345.368	30.000	77.587	20722.080	21217.080	5.894	145.66	0.035	0.081					
375.386	30.001	77.587	22523.160	23018.160	6.394	151.72	0.035	0.079					
405.397	30.000	77.587	24323.820	24818.820	6.894	157.54	0.034	0.079					
435.418	30.000	77.586	26125.080	26620.080	7.394	163.16	0.034	0.077					
465.456	30.000	77.585	27927.360	28422.360	7.895	168.59	0.033	0.075					
495.551	30.001	77.585	29733.060	30228.060	8.397	173.86	0.033	0.075					
525.647	30.000	77.585	31538.820	32033.820	8.898	178.98	0.032	0.074					
555.692	30.000	77.585	33341.520	33836.520	9.399	183.95	0.032	0.074					
585.714	30.001	77.585	35142.840	35637.840	9.899	188.78	0.032	0.073					
615.769	30.000	77.585	36946.140	37441.140	10.400	193.50	0.032	0.072					
645.776	30.001	77.584	38748.560	39241.560	10.900	198.09	0.031	0.071					
675.803	30.000	77.584	40548.180	41043.180	11.401	202.59	0.031	0.071					
705.829	30.000	77.584	42349.740	42844.740	11.901	206.99	0.031	0.070					
735.854	30.000	77.584	44151.240	44646.240	12.402	211.30	0.031	0.070					
765.944	30.000	77.584	45956.640	46451.640	12.903	215.53	0.030	0.069					
795.979	30.001	77.583	47758.740	48253.740	13.404	219.67	0.030	0.068					
826.024	30.000	77.583	49561.440	50056.440	13.905	223.73	0.030	0.067					
856.048	30.001	77.583	51362.880	51857.880	14.405	227.72	0.029	0.066					
886.072	30.000	77.582	53164.320	53659.320	14.905	231.64	0.029	0.066					
916.091	30.000	77.582	54965.460	55460.460	15.406	235.50	0.028	0.065					
946.139	30.000	77.582	56768.340	57263.340	15.906	239.30	0.028	0.064					
976.202	30.000	77.581	58572.120	59067.120	16.408	243.04	0.027	0.063					
1006.219	30.000	77.581	60373.140	60868.140	16.908	246.71	0.027	0.062					
1036.236	30.000	77.581	62174.160	62669.160	17.408	250.34	0.027	0.062					
1066.270	30.000	77.581	63976.200	64471.200	17.909	253.91	0.027	0.062					
1096.330	30.000	77.581	65779.800	66274.800	18.410	257.44	0.027	0.062					
1126.394	30.000	77.581	67583.640	68078.640	18.911	260.92	0.027	0.062					

Formulae Used for Analysis of Data
 Uppercase letters refer to columns
 Lowercase n refers to row, beginning with n=4

 $Dn = (An \cdot 60)$
 $En = (Dn + M4)$
 $Fn = (En / 3600)$
 $Gn = SQRT(En)$
 $Hn = (((Cn - L4) / L4) \cdot 100)$
 $In = ((Cn - L4) / (J4 - L4))$
 $K4 = (((J4 - L4) / (J4 - L4)) \cdot 100)$
 $N16 = (((N12 - N8) / N8) \cdot 100)$

 Source binary TA data file : pdms139d.01
 14 lines in the parameter block
 3 channels of data

 Run 42
 Module TGA Aluminum Pans
 Sample PDMS Glove SC02 139d Disk
 Size 77.661 mg
 Method DESORPTION-Isothermal
 Operator ws
 Comment .335"x.047",HP@1400x50,Dry:DS-77.5 M-77.50 TG-77.560 ET: 8:15
 Nsig 3
 Sig1 Time (min)
 Sig2 Temperature (°C)
 Sig3 Weight (mg)
 Kcell 1.0000
 Date 18-May-00
 Time 14:09

Blank

Sorption, Desorption Diffusion, and Indentation Data Sets

Material Data

Test Reference Number:	<u>10-1-1</u>	TGA Filename:	<u>pbb0138d</u>
Property Test Specification:	ASTM D471/D543		
Material Name:	<u>Polybromobutylene-isoprene</u>	Material Code:	<u>PBB</u>
Material Supplier:	<u>Smithers Scientific</u>	Material Class:	<u>BIIR</u>
Monomer Source:	<u>Miles/Dupont</u>	Base Polymer (Lot. No.):	<u>Unknown</u>
Exposure Liquid:	Supercritical Carbon Dioxide	Replicate Number:	1

Pre-Exposure Data

Measured Diameter (mm):	<u>8.50</u>	<u>8.6</u>	<u>8.51</u>	<u>8.52</u>	
Mean Diameter:	<u>8.515</u>				95% Confidence Level (CL): <u>0.073</u>
Measured Thickness (mils):	<u>41.40</u>	<u>41.60</u>	<u>41.60</u>	<u>41.40</u>	
Mean Thickness:	<u>41.500</u>				95% Confidence Level (CL): <u>0.184</u>
Initial Sample Weight (mg):	<u>68.350</u>				
Initial Durometer Hardness:	65.9	Scale: SHORE		A	

Sample Exposure Data

Exposure Date:	<u>05/17/00</u>	Time:	<u>10:06:00</u>
Removal Date:	<u>05/17/00</u>	Time:	<u>10:21:00</u>
Total Exposure Time (h:m:s):	<u>00:15:00</u>	Weight of Sample After Exposure (mg):	<u>70.40</u>
Weight Gain (mg):	<u>2.05</u>	Percent Weight Gain:	<u>3.00</u>
Final Durometer Hardness After Desorption:	67.8	Percent Hardness Change:	<u>2.9</u>

Desorption Experiment

Mean Temperature of Desorption Experiment (setpoint = 30 deg C):	<u>30.000</u>	95% CL:	<u>0.0011</u>
Time Lapse Between Sample Exposure and Sample Desorption (sec):			<u>685</u>
Equilibrium Weight of Desorbed Sample at 30 deg C (mg):			<u>68.270</u>
Sample Extracted (mg):	<u>0.08</u>	Solubility Corrected for Extractables (mg):	<u>2.13</u>
Sample Extracted (%):	<u>0.12</u>	Solubility Corrected for Extractables (%):	<u>3.12</u>

Diffusion Coefficient Data: Fick's Law

High Concentration Diffusion Coefficient (cm ² /sec):	8.4153E-07
Range Including 0,1 Intercept, Relative Weight Fraction:	1.00 - 0.35
Linear Range of Desorption, Relative Weight Fraction:	0.49 - 0.35
Slope: <u>-1.9640E-02</u>	X-axis Intercept: 5.0890E+01
R Square: <u>0.99983</u>	Y-axis Intercept: 9.9947E-01

Low Concentration Diffusion Coefficient (cm2/sec):	<u>7.9684E-11</u>
Linear Range of Desorption, Relative Weight Fraction:	<u>0.04 - 0.00</u>
Slope:	<u>-1.9111E-04</u>
X-axis Intercept:	<u>2.9056E+02</u>
R Square:	<u>0.98726</u>
Y-axis Intercept:	<u>5.5529E-02</u>

Wt. @ Zero Time, mg K 70.40	Wt. @ Zero Time, % L 2.999	Adjustment to TGA Time, sec M 685	Hardness Shore Scale N A
TGA Dry Wt., mg 68.350	Equil. Wt. Of Desorb. Sample 68.27	Min. Wt. Used For FDC, mg. 68.270	Pre Exposure Hardness 65.9
High Conc. DC, cm2/sec 8.4153E-07	Low Conc. DC, cm2/sec 7.9684E-11	Total Liquid Sorbed, mg. 2.050	Post Desorption Hardness 67.8
R Square 0.99983	R Square 0.98726		Change in Hardness, % 2.9
X Intercept 50.89	X Intercept 290.6		Mean Thickness, cm. 0.1054
Y Intercept 0.99947	Y Intercept 0.05553		
Y Intercept as Wt., mg. 70.363	X Intercept as Time, hrs. 23.5	X Intercept as Time, min. 140.7	pbb0138d X Intercept as Time, days 1.0

TEMPERATURE STATISTICS

<i>Column1</i>		Max. TGA Wt., (orig data file) 69.317	TGA Wt. At 20 min. Adjustment 68.966
Mean	30.0001569	Sorption @ 7-12 min., mg	Sorption @ 20 min., mg
Standard Error	0.000576801	0.97	0.62
Median	30		
Mode	30	Sorption @ 7-12 min., %	Sorption @ 20 min., %
Standard Deviation	0.030787355	1.41	0.90
Sample Variance	0.000947861		
Kurtosis	450.4323926	Rel. Error (%) of 7-12 min. Sorp.	Rel. Error (%) of 20 min. Sorp
Skewness	-14.59614998	-52.8	-70.0
Range	1.259		
Minimum	29.054		
Maximum	30.313		
Sum	85470.447		
Count	2849		
Confidence Level(95.0%)	0.001130991		

DIAMETER STATISTICS

<i>Column1</i>	
Mean	8.5325
Standard Error	0.02286737
Median	8.515
Mode	#N/A
Standard Deviation	0.04573474
Sample Variance	0.00209167
Kurtosis	3.3803273
Skewness	1.81106705
Range	0.1
Minimum	8.5
Maximum	8.6
Sum	34.13
Count	4
Confidence Level(95.0%)	0.07277425

ND/value
ND/value
A/D

THICKNESS STATISTICS

<i>Column1</i>	
Mean	41.5
Standard Error	0.05773503
Median	41.5
Mode	41.4
Standard Deviation	0.11547005
Sample Variance	0.01333333
Kurtosis	-6
Skewness	0
Range	0.2
Minimum	41.4
Maximum	41.6
Sum	166
Count	4
Confidence Level(95.0%)	0.1837388

Unknown
pbb0138d

HIGH CONCENTRATION DIFFUSION COEFFICIENT

pbb0138d

SUMMARY OUTPUT

<i>Regression Statistics</i>	
Multiple R	0.99991495
R Square	0.999829908
Adjusted R Square	0.999817759
Standard Error	0.002070178
Observations	16

ANOVA

	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	1	0.352684355	0.352684355	82294.5048	8.62865E-28
Residual	14	5.99989E-05	4.28564E-06		
Total	15	0.352744354			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>
Intercept	0.999472153	0.001994127	501.2079449	3.4963E-31	0.995195172	1.003749133
X Variable 1	-0.019639835	6.84624E-05	-286.8701881	8.6287E-28	-0.019786673	-0.019492998

LOW CONCENTRATION DIFFUSION COEFFICIENT

SUMMARY OUTPUT

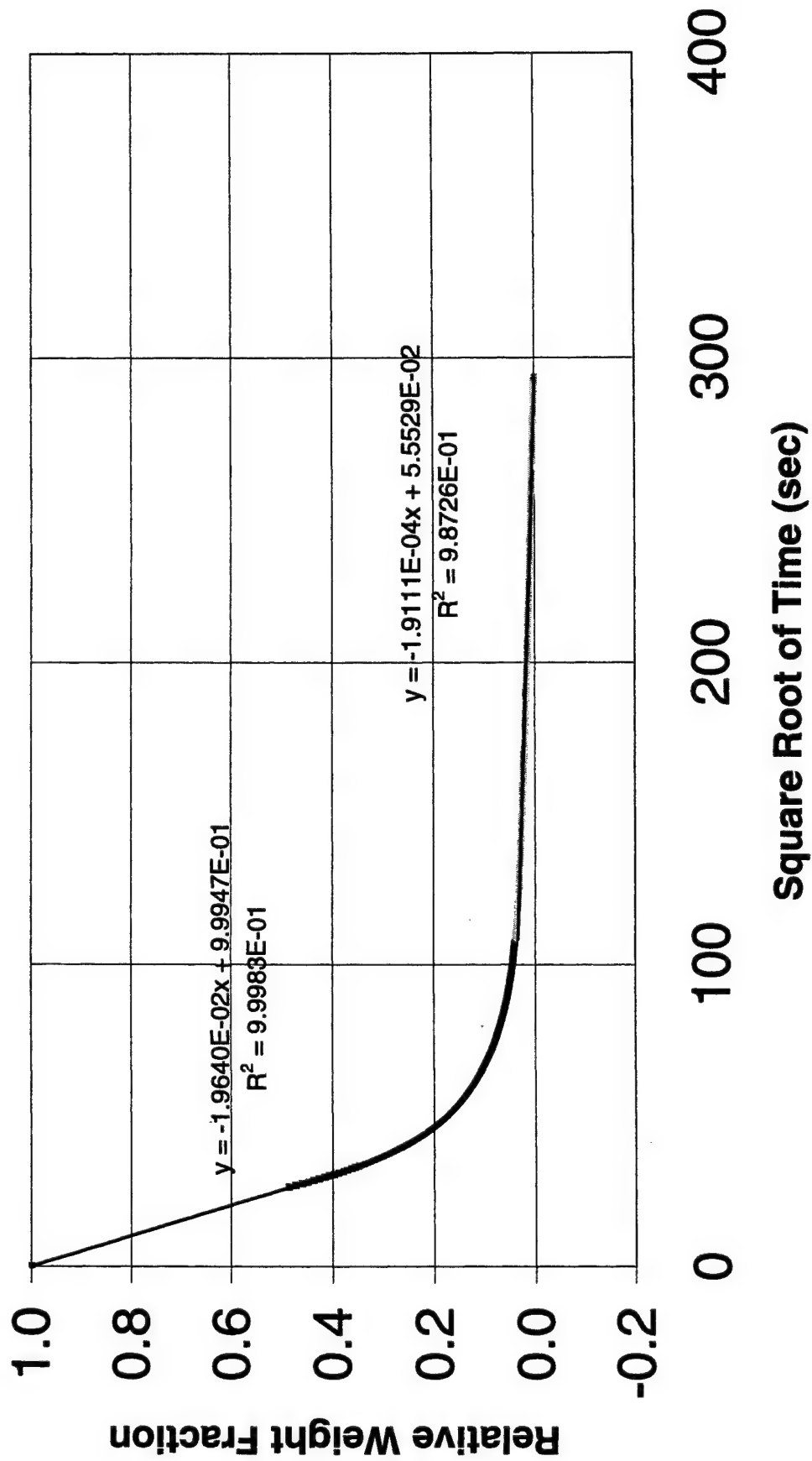
<i>Regression Statistics</i>	
Multiple R	0.993609146
R Square	0.987259134
Adjusted R Square	0.987253995
Standard Error	0.001120332
Observations	2481

ANOVA

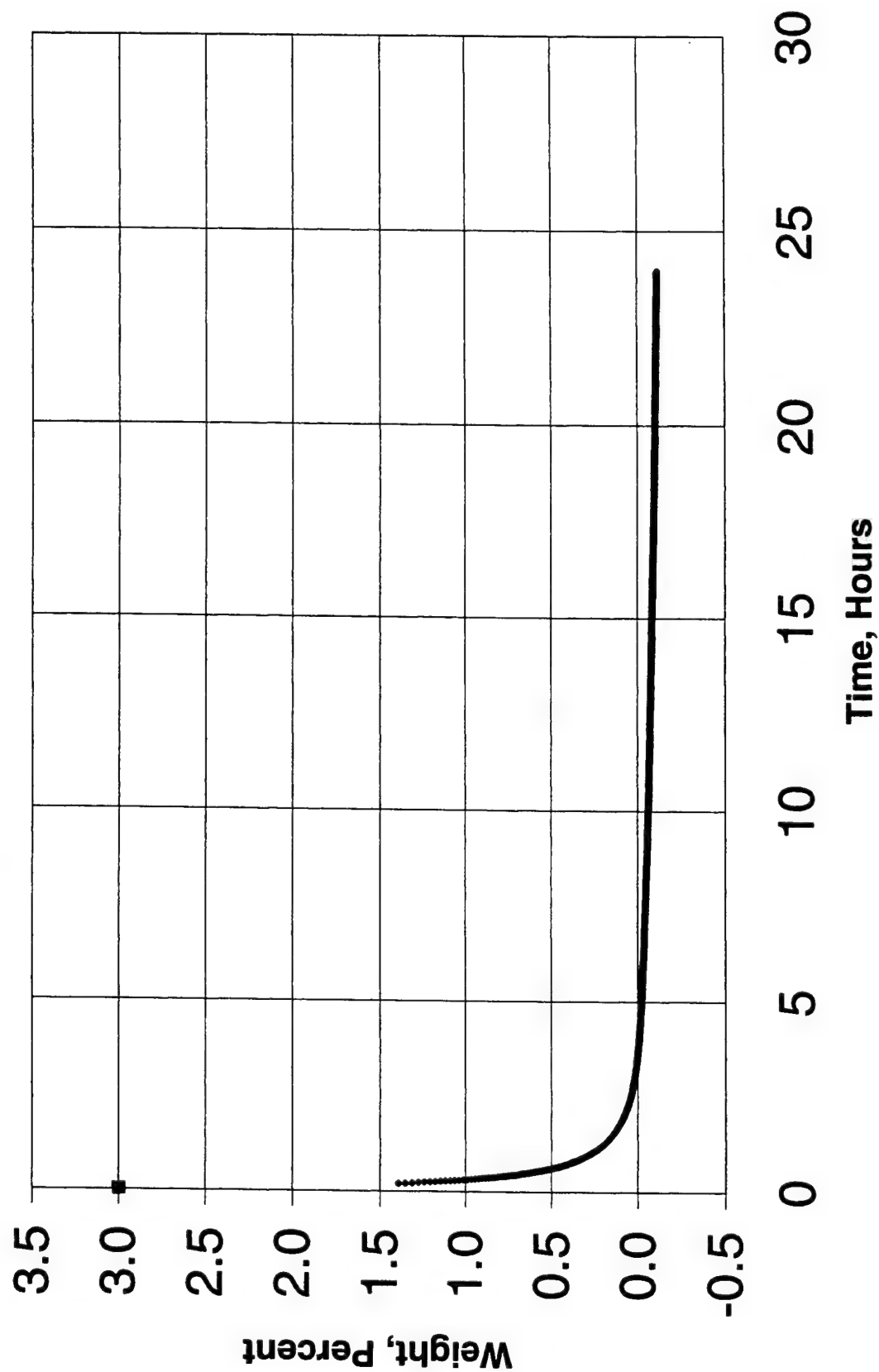
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	1	0.241102733	0.241102733	192091.765	0
Residual	2479	0.003111501	1.25514E-06		
Total	2480	0.244214234			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>
Intercept	0.055529087	9.65065E-05	575.3920966	0	0.055339846	0.055718329
X Variable 1	-0.000191113	4.36049E-07	-438.2827455	0	-0.000191968	-0.000190258

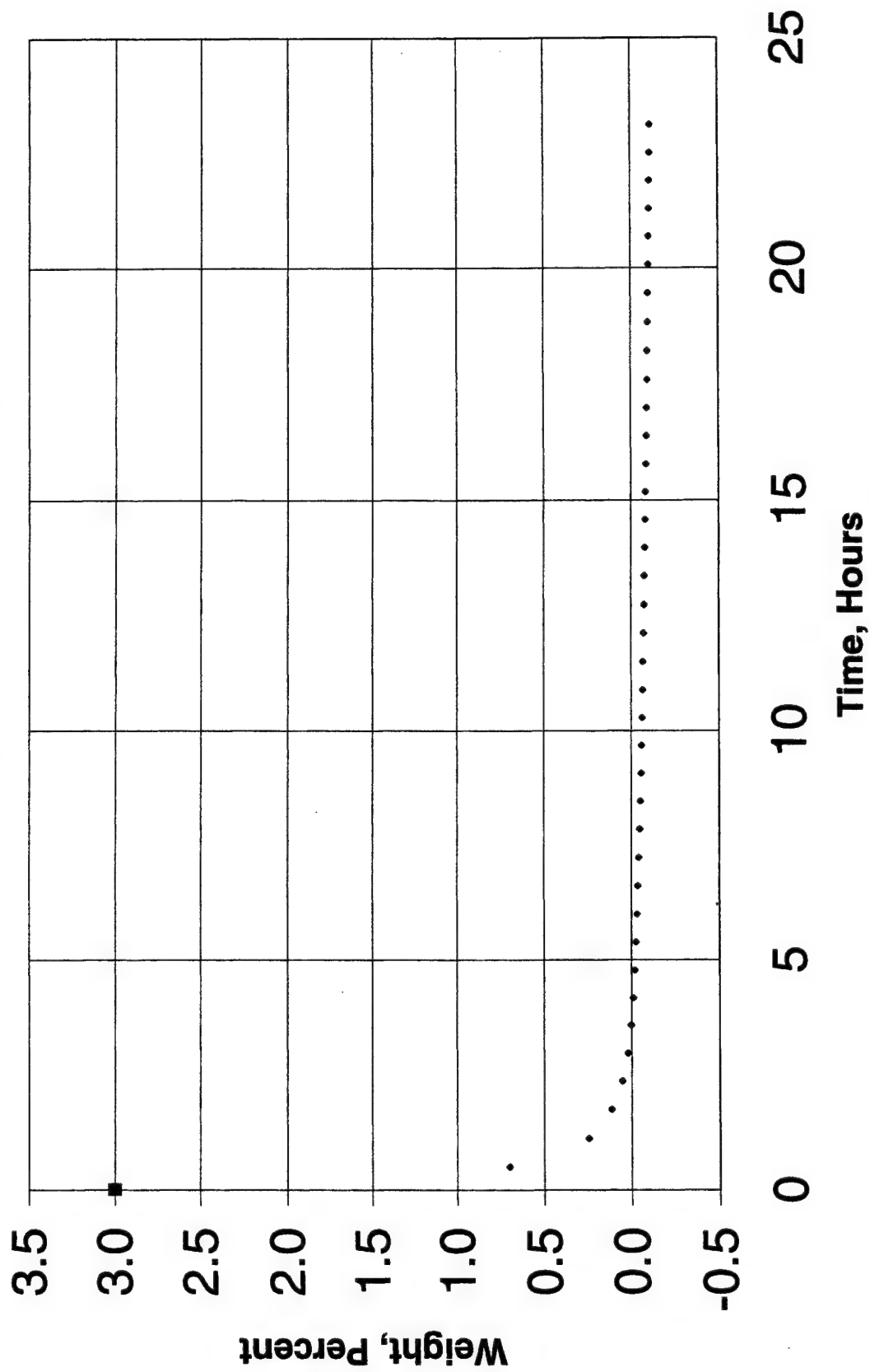
**Figure . Fick's Law Plot of Desorption Diffusion (30 degrees C)
of Supercritical Carbon Dioxide from Polymeric Materials:
PBB (0138d)**



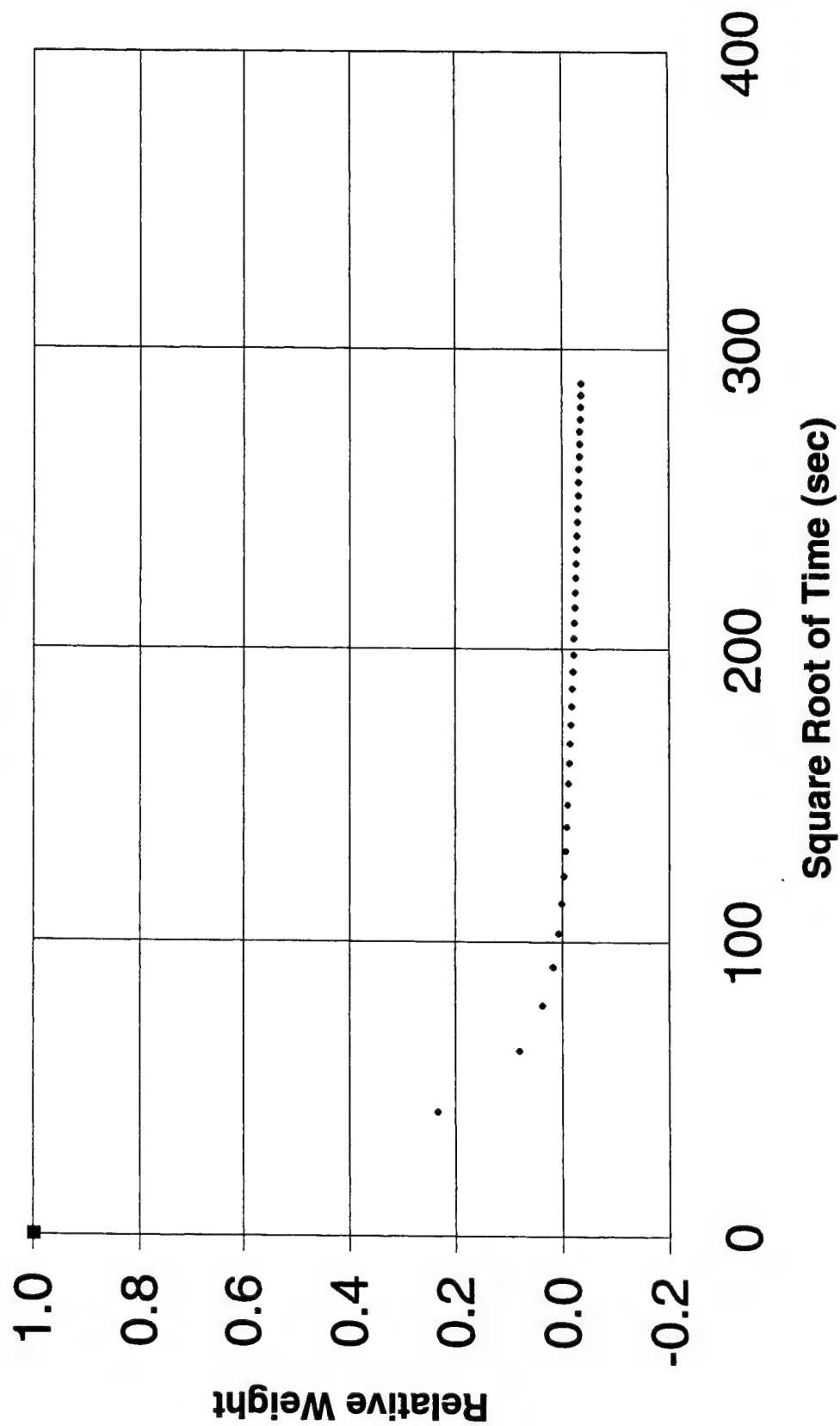
**Figure . Desorption Diffusion (30 degrees C) of Supercritical
Carbon Dioxide from Polymeric Materials: PBB (0138d)**



**Figure . Desorption Diffusion (30 degrees C) of Supercritical
Carbon Dioxide from Polymeric Materials: PBB (0138d)**



**Figure . Fick's Law Plot of Desorption Diffusion (30 degrees C) of
Supercritical Carbon Dioxide from Polymeric Materials:
PBB (0138d)**



TGA Time, min	Temp., deg C	TGA Wt., mg	TGA Time, sec	Adjusted Time, sec	Adjusted Time, hr	SQRT Adj. Time, sec	Wt. Loss, %	Fractional Wt. Loss	Wt. @ Zero Time, mg	Wt. @ Zero Time, %	TGA Dry Wt., mg	Adjustment to TGA Time, sec	Hardness Scale
A	B	C	D	E	F	G	H	I	J	K	L	M	N
18.250	29.999	68.827	1095.000	1780.000	0.494	42.19	0.699	0.233	70.40	3.001	68.349	685	Shore A
54.923	29.999	68.516	3295.380	3980.380	1.106	63.09	0.244	0.081					
91.618	30.000	68.427	5497.080	6182.080	1.717	78.63	0.114	0.038					
126.308	30.000	68.386	7698.480	8383.480	2.329	91.56	0.054	0.018					
164.995	30.000	68.364	9899.700	10584.700	2.940	102.88	0.022	0.007					
201.697	30.000	68.351	12101.820	12786.820	3.552	113.08	0.003	0.001					
238.392	30.001	68.343	14303.520	14988.520	4.163	122.43	-0.009	-0.003					
275.072	30.000	68.337	16504.320	17189.320	4.775	131.11	-0.018	-0.006					
311.783	30.000	68.332	18706.980	19391.980	5.387	139.26	-0.025	-0.008					
348.510	30.000	68.328	20910.600	21595.600	5.999	146.95	-0.031	-0.010					
385.211	30.000	68.325	23112.660	23797.660	6.610	154.26	-0.036	-0.012					
421.910	30.000	68.321	25314.600	25999.600	7.222	161.24	-0.041	-0.014					
458.737	30.001	68.318	27524.220	28209.220	7.836	167.96	-0.045	-0.015					
495.466	30.000	68.315	29727.960	30412.960	8.448	174.39	-0.050	-0.017					
532.159	30.000	68.312	31929.540	32614.540	9.060	180.59	-0.054	-0.018					
568.842	30.000	68.310	34130.520	34815.520	9.671	186.59	-0.058	-0.019					
605.517	30.000	68.307	36331.020	37016.020	10.282	192.40	-0.061	-0.020					
642.214	30.000	68.305	38532.840	39217.840	10.894	198.03	-0.065	-0.022					
678.898	30.000	68.303	40733.880	41418.880	11.505	203.52	-0.067	-0.022					
715.596	30.000	68.301	42935.760	43620.760	12.117	208.86	-0.070	-0.023					
752.319	30.000	68.300	45139.140	45824.140	12.729	214.07	-0.072	-0.024					
789.039	30.000	68.298	47342.340	48027.340	13.341	219.15	-0.075	-0.025					
825.791	30.000	68.296	49547.460	50232.460	13.953	224.13	-0.078	-0.026					
862.502	30.000	68.294	51750.120	52435.120	14.565	228.99	-0.081	-0.027					
898.199	30.001	68.292	53951.940	54636.940	15.177	233.75	-0.083	-0.028					
935.865	30.000	68.291	56153.100	56838.100	15.788	238.41	-0.085	-0.028					
972.560	30.000	68.289	58353.600	59038.600	16.400	242.98	-0.088	-0.029					
1009.237	30.001	68.287	60554.220	61239.220	17.011	247.47	-0.090	-0.030					
1045.915	30.000	68.286	62754.900	63439.900	17.622	251.87	-0.093	-0.031					
1082.614	30.000	68.284	64956.840	65641.840	18.234	256.21	-0.095	-0.032					
1119.318	30.000	68.283	67159.080	67844.080	18.846	260.47	-0.097	-0.032					
1156.067	30.000	68.282	69364.020	70049.020	19.458	264.67	-0.099	-0.033					
1192.838	30.000	68.280	71570.280	72255.280	20.071	268.80	-0.101	-0.034					
1229.534	30.000	68.279	73772.040	74457.040	20.683	272.87	-0.103	-0.034					
1266.229	30.000	68.277	75973.740	76658.740	21.294	276.87	-0.105	-0.035					
1302.923	30.000	68.276	78175.380	78860.380	21.906	280.82	-0.107	-0.036					
1339.633	30.000	68.274	80377.980	81062.980	22.517	284.72	-0.109	-0.036					
1376.322	30.000	68.273	82579.320	83264.320	23.129	288.56	-0.111	-0.037					

Pre Exposure
Hardness
65.9

Post Desorption
Hardness
67.8

Change in
Hardness, %
2.88

Formulae Used for Analysis of Data
Upper case letters refer to columns
Lower case n refers to row, beginning with n=4

 $Dn = (An * 60)$
 $En = (Dn + M4)$
 $Fn = (En / 3600)$
 $Gn = SQRT(En)$
 $Hn = (((Cn - L4) / L4) * 100)$
 $In = ((Cn - L4) / (J4 - L4))$
 $K4 = (((J4 - L4) / L4) * 100)$
 $N16 = (((N12 - N8) / N8) * 100)$

Source binary TA data file : pbb0138d.01
 14 lines in the parameter block
 3 channels of data

 Run 41
 Module TGA Aluminum Pans
 Sample PBRB-IP 43 Mask SC72 0138D Disk
 Size 69.317 mg
 Method DESORPTION-Isothermal
 Operator BSI
 Comment .336"x.042" HP @ 1400x50, Dry: DS-68.4 M-68.28 TG-68.349 ET: 11:25
 Nsig 3

Sig1 Time (min)
 Sig2 Temperature (°C)
 Sig3 Weight (mg)
 Kcell 1.0000
 Date 17-May-00
 Time 10:33

Blank

FIGURE . CHEMICAL-MATERIAL INTERACTION DATA SET:**Supercritical Carbon Dioxide and Polyisobutylene-isoprene****PIB****Sorption, Desorption Diffusion, and Indentation Data Sets****Material Data**

Test Reference Number:	<u>11-1-1</u>	TGA Filename:	<u>pib0137d</u>
Property Test Specification:	ASTM D471/D543		
Material Name:	<u>Polyisobutylene-isoprene</u>	Material Code:	<u>PIB</u>
Material Supplier:	<u>Smithers Scientific</u>	Material Class:	<u>IIR</u>
Monomer Source:	<u>Polysar Rubber</u>	Base Polymer (Lot. No.):	<u>Butyl 301</u>
Exposure Liquid:	<u>Supercritical Carbon Dioxide</u>	Replicate Number:	<u>1</u>

Pre-Exposure Data

Measured Diameter (mm):	<u>6.64</u>	<u>6.64</u>	<u>6.62</u>	<u>6.63</u>	
Mean Diameter:	<u>6.635</u>				
Measured Thickness (mils):	<u>41.00</u>	<u>41.00</u>	<u>40.40</u>	<u>40.30</u>	
Mean Thickness:	<u>40.675</u>				
Initial Sample Weight (mg):	<u>37.540</u>				
Initial Durometer Hardness:	<u>66.2</u>	Scale: SHORE	<u>A</u>		
					95% Confidence Level (CL): <u>0.015</u>
					95% Confidence Level (CL): <u>0.601</u>

Sample Exposure Data

Exposure Date:	<u>05/16/00</u>	Time:	<u>13:23:00</u>	
Removal Date:	<u>05/16/00</u>	Time:	<u>13:38:00</u>	
Total Exposure Time (h:m:s):	<u>00:15:00</u>	Weight of Sample After Exposure (mg):	<u>40.50</u>	
Weight Gain (mg):	<u>2.96</u>	Percent Weight Gain:	<u>7.88</u>	
Final Durometer Hardness After Desorption:	<u>67.7</u>	Percent Hardness Change:	<u>2.3</u>	

Desorption Experiment

Mean Temperature of Desorption Experiment (setpoint = 30 deg C):	<u>30.000</u>	95% CL:	<u>0.0014</u>
Time Lapse Between Sample Exposure and Sample Desorption (sec):			<u>545</u>
Equilibrium Weight of Desorbed Sample at 30 deg C (mg):			<u>37.590</u>
Sample Extracted (mg):	<u>-0.05</u>	Solubility Corrected for Extractables (mg):	<u>2.96</u>
Sample Extracted (%):	<u>-0.13</u>	Solubility Corrected for Extractables (%):	<u>7.88</u>

Diffusion Coefficient Data: Fick's Law

High Concentration Diffusion Coefficient (cm ² /sec):	<u>7.7950E-07</u>
Range Including 0,1 Intercept, Relative Weight Fraction:	<u>1.00 - 0.40</u>
Linear Range of Desorption, Relative Weight Fraction:	<u>0.55 - 0.40</u>
Slope:	<u>-1.9286E-02</u>
X-axis Intercept:	<u>5.1799E+01</u>
R Square:	<u>0.99988</u>
Y-axis Intercept:	<u>9.9897E-01</u>

Low Concentration Diffusion Coefficient (cm ² /sec):	<u>3.0844E-11</u>
Linear Range of Desorption, Relative Weight Fraction:	<u>0.04 - 0.02</u>
Slope:	<u>-1.2131E-04</u>
X-axis Intercept:	<u>3.3677E+02</u>
R Square:	<u>0.75955</u>
Y-axis Intercept:	<u>4.0855E-02</u>

Wt. @ Zero Time, mg K 40.50	Wt. @ Zero Time, % L 7.885	Adjustment to TGA Time, sec M 545	Hardness Shore Scale N A
TGA Dry Wt., mg 37.540	Equil. Wt. Of Desorb. Sample 37.59	Min. Wt. Used For FDC, mg. 37.540	Pre Exposure Hardness 66.2
High Conc. DC, cm2/sec 7.7950E-07	Low Conc. DC, cm2/sec 3.0844E-11	Total Liquid Sorbed, mg. 2.960	Post Desorption Hardness 67.7
R Square 0.99988	R Square 0.75955		Change in Hardness, % 2.3
X Intercept 51.80	X Intercept 336.8		Mean Thickness, cm. 0.1033
Y Intercept 0.99897	Y Intercept 0.04085		
Y Intercept as Wt., mg. 40.458	X Intercept as Time, hrs. 31.5	X Intercept as Time, min. 189.0	plb0137d X Intercept as Time, days 1.3

TEMPERATURE STATISTICS

<i>Column1</i>		Max. TGA Wt., (orig data file) 39.176	TGA Wt. At 20 min. Adjustment 38.562
Mean	29.99950594	Sorption @ 7-12 min., mg	Sorption @ 20 min., mg
Standard Error	0.000739013	1.64	1.02
Median	30		
Mode	29.999	Sorption @ 7-12 min., %	Sorption @ 20 min., %
Standard Deviation	0.029551293	4.36	2.72
Sample Variance	0.000873279		
Kurtosis	429.8792472	Rel. Error (%) of 7-12 min. Sorp.	Rel. Error (%) of 20 min. Sorp
Skewness	-17.48325949	-44.7	-65.5
Range	0.988		
Minimum	29.192		
Maximum	30.18		
Sum	47969.21		
Count	1599		
Confidence Level(95.0%)	0.001449536		

DIAMETER STATISTICS

<i>Column1</i>	
Mean	6.6325
Standard Error	0.00478714
Median	6.635
Mode	6.64
Standard Deviation	0.00957427
Sample Variance	9.1667E-05
Kurtosis	-1.2892562
Skewness	-0.854563
Range	0.02
Minimum	6.62
Maximum	6.64
Sum	26.53
Count	4
Confidence Level(95.0%)	0.01523482

THICKNESS STATISTICS

<i>Column1</i>	
Mean	40.675
Standard Error	0.18874586
Median	40.7
Mode	41
Standard Deviation	0.37749172
Sample Variance	0.1425
Kurtosis	-5.6522007
Skewness	-0.0604173
Range	0.7
Minimum	40.3
Maximum	41
Sum	162.7
Count	4
Confidence Level(95.0%)	0.60067413

HIGH CONCENTRATION DIFFUSION COEFFICIENT

pib0137d

SUMMARY OUTPUT

<i>Regression Statistics</i>	
Multiple R	0.999940638
R Square	0.999881279
Adjusted R Square	0.999872798
Standard Error	0.00158408
Observations	16

ANOVA

	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	1	0.295870343	0.295870343	117909.114	6.96392E-29
Residual	14	3.51303E-05	2.50931E-06		
Total	15	0.295905474			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>
Intercept	0.998966023	0.001504051	664.1835269	6.7905E-33	0.995740151	1.002191895
X Variable 1	-0.019285518	5.61639E-05	-343.3789662	6.9639E-29	-0.019405978	-0.019165058

LOW CONCENTRATION DIFFUSION COEFFICIENT

SUMMARY OUTPUT

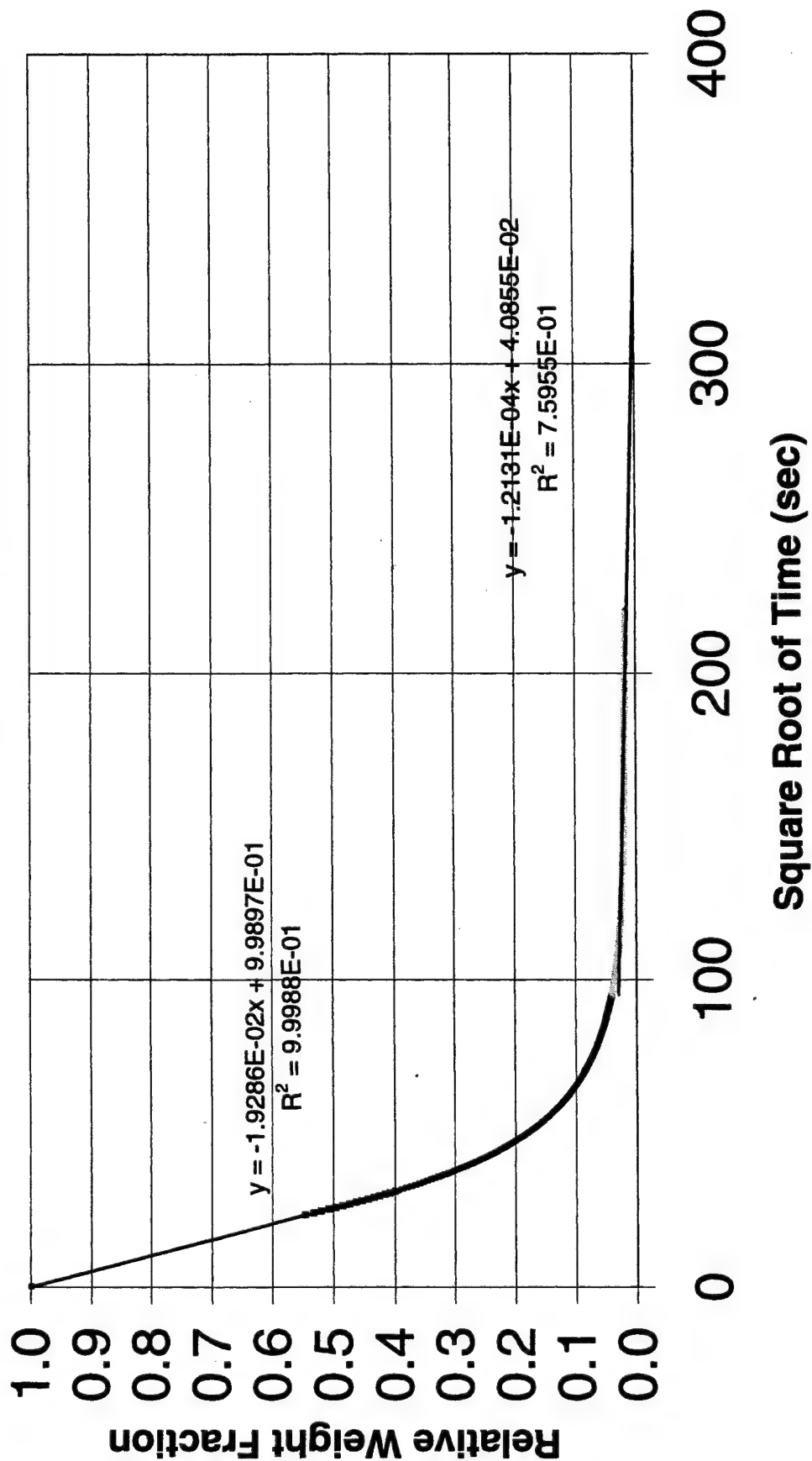
<i>Regression Statistics</i>	
Multiple R	0.871521284
R Square	0.759549349
Adjusted R Square	0.759366357
Standard Error	0.002404989
Observations	1316

ANOVA

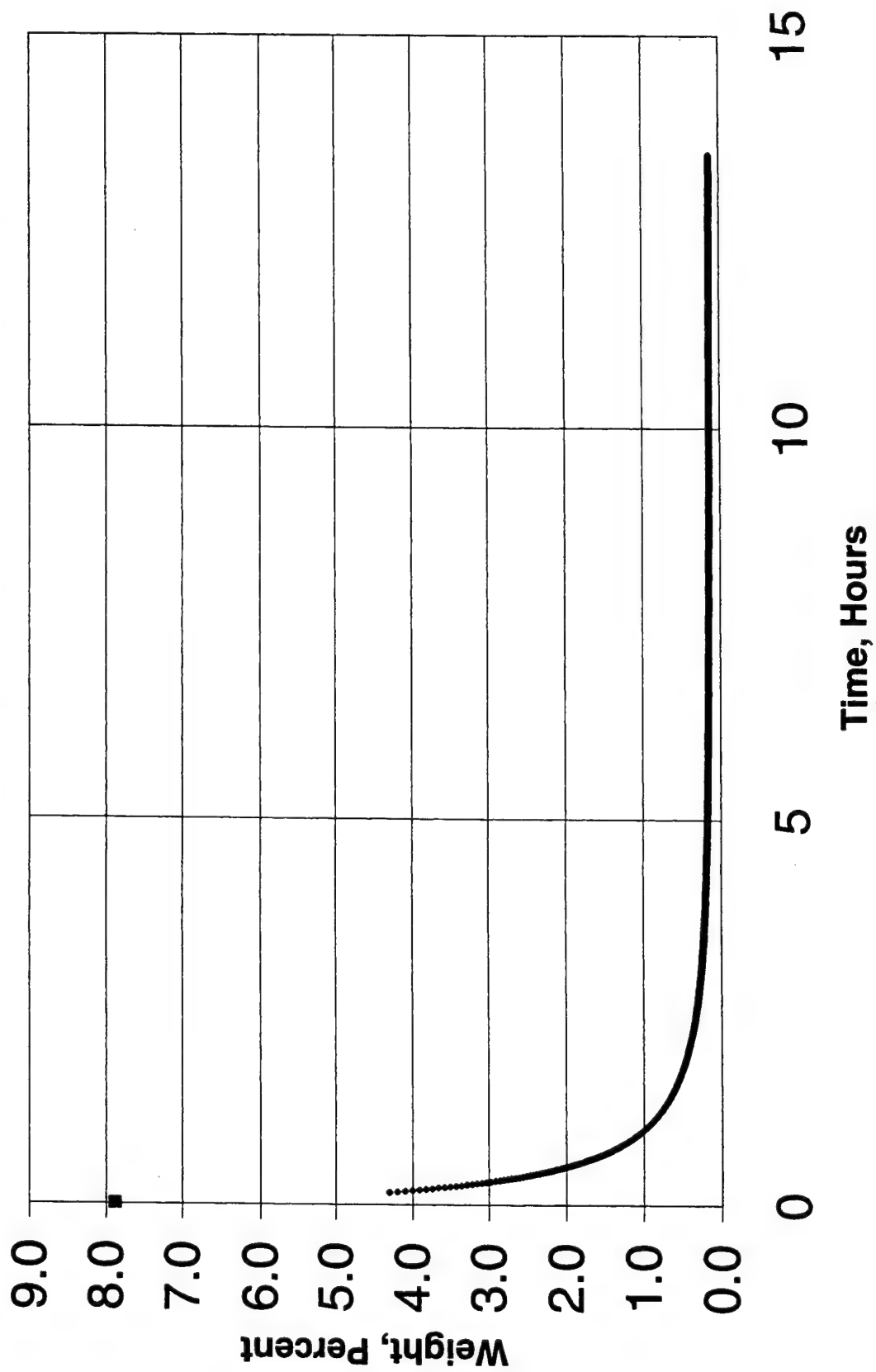
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	1	0.024007766	0.024007766	4150.73879	0
Residual	1314	0.007600142	5.78397E-06		
Total	1315	0.031607908			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>
Intercept	0.040854876	0.000319502	127.8703396	0	0.040228086	0.041481667
X Variable 1	-0.000121314	1.88299E-06	-64.42622748	0	-0.000125008	-0.00011762

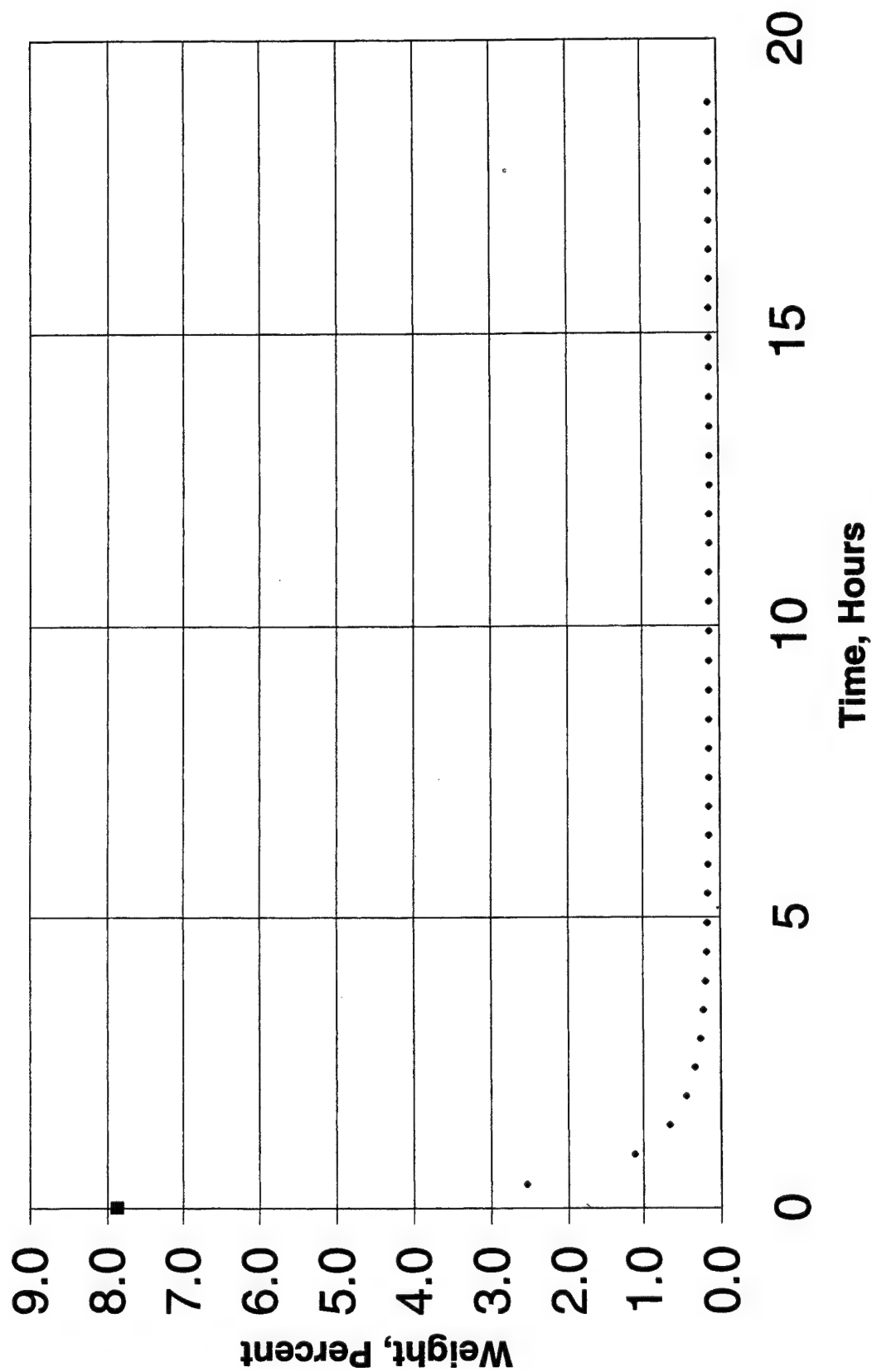
**Figure . Fick's Law Plot of Desorption Diffusion (30 degrees C)
of Supercritical Carbon Dioxide from Polymeric Materials:
PIB (0137d)**



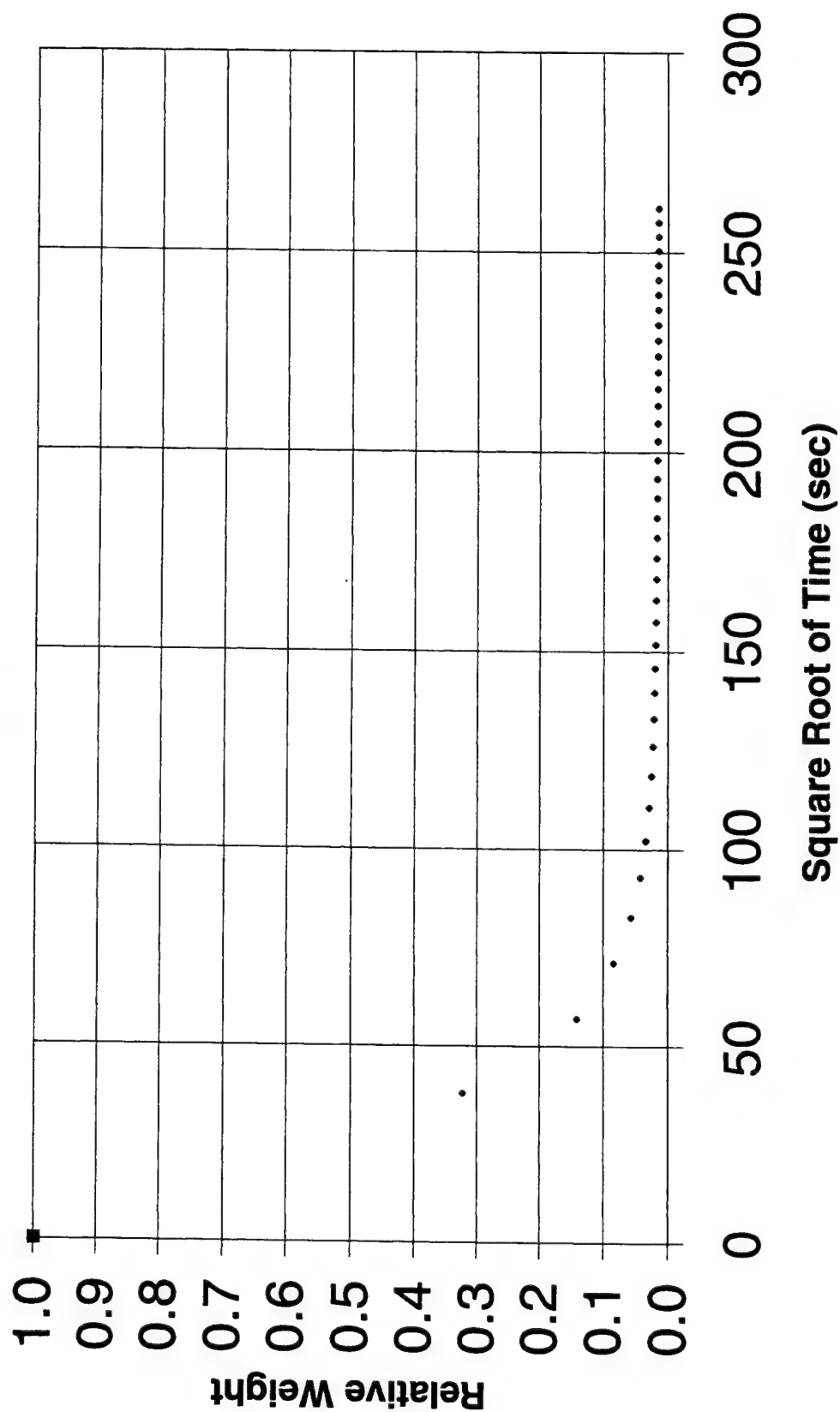
**Figure . Desorption Diffusion (30 degrees C) of Supercritical
Carbon Dioxide from Polymeric Materials: PIB (0137d)**



**Figure . Desorption Diffusion (30 degrees C) of Supercritical
Carbon Dioxide from Polymeric Materials: PIB (0137d)**



**Figure . Fick's Law Plot of Desorption Diffusion (30 degrees C) of
Supercritical Carbon Dioxide from Polymeric Materials:
PIB (0137d)**



TGA Time, min	Temp., deg C	TGA Wt., mg	TGA Time, sec	Adjusted Time, sec	Adjusted Time, hr	SQRT Adj. Time, sec	Wt. Loss, %	Fractional Wt. Loss	Wt. @ Zero Time, mg	Wt. @ Zero Time, %	TGA Dry Wt., mg	Adjustment to TGA Time, sec	Hardness Scale
A	B	C	D	E	F	G	H	I	J	K	L	M	N
14.916	29.982	38.498	894.960	1439.960	0.400	37.95	2.543	0.323	40.50	7.876	37.543	545	Shore A
44.916	30.000	37.960	2695.080	3240.080	0.900	56.92	1.111	0.141					
74.933	30.001	37.790	4495.980	5040.980	1.400	71.00	0.658	0.083					
104.958	30.000	37.711	6297.480	6842.480	1.901	82.72	0.446	0.057					
134.974	30.001	37.668	8098.440	8643.440	2.401	92.97	0.332	0.042					
164.992	30.000	37.642	9899.520	10444.520	2.901	102.20	0.264	0.034					
195.016	30.000	37.627	11700.960	12245.960	3.402	110.66	0.223	0.028					
225.039	30.000	37.617	13502.340	14047.340	3.902	118.52	0.197	0.025					
255.043	30.000	37.611	15302.580	15847.580	4.402	125.89	0.181	0.023					
285.051	30.001	37.607	17103.060	17648.060	4.902	132.85	0.169	0.021					
315.067	30.000	37.603	18904.020	19449.020	5.403	139.46	0.161	0.020					
345.107	30.000	37.601	20706.420	21251.420	5.903	145.78	0.155	0.020					
375.139	30.000	37.599	22508.340	23053.340	6.404	151.83	0.150	0.019					
405.184	30.000	37.598	24311.040	24856.040	6.904	157.66	0.146	0.019					
435.194	30.000	37.597	26111.640	26656.640	7.405	163.27	0.143	0.018					
465.256	30.000	37.596	27915.360	28460.360	7.906	168.70	0.141	0.018					
495.331	30.000	37.595	29719.860	30264.860	8.407	173.97	0.139	0.018					
525.358	30.000	37.594	31521.480	32066.480	8.907	179.07	0.137	0.017					
555.390	30.000	37.594	33323.400	33868.400	9.408	184.03	0.135	0.017					
585.407	30.000	37.593	35124.420	35669.420	9.908	188.86	0.133	0.017					
615.415	30.000	37.593	36924.900	37469.900	10.408	193.57	0.132	0.017					
645.425	30.000	37.592	38725.500	39270.500	10.908	198.17	0.130	0.017					
675.468	30.000	37.591	40528.080	41073.080	11.409	202.66	0.128	0.016					
705.488	30.000	37.591	42329.280	42874.280	11.910	207.06	0.127	0.016					
735.506	30.000	37.590	44130.360	44675.360	12.410	211.37	0.126	0.016					
765.525	30.000	37.590	45931.500	46476.500	12.910	215.58	0.124	0.016					
795.537	30.000	37.589	47732.220	48277.220	13.410	219.72	0.123	0.016					
825.559	30.000	37.589	49533.540	50078.540	13.911	223.78	0.123	0.016					
855.621	30.000	37.589	51337.260	51882.260	14.412	227.78	0.122	0.015					
885.666	30.000	37.588	53139.960	53684.960	14.912	231.70	0.121	0.015					
915.676	30.001	37.588	54940.560	55485.560	15.413	235.55	0.120	0.015					
945.693	30.000	37.588	56741.580	57286.580	15.913	239.35	0.119	0.015					
975.726	30.000	37.587	58543.560	59088.560	16.413	243.08	0.118	0.015					
1005.742	30.000	37.587	60344.520	60889.520	16.914	246.76	0.117	0.015					
1035.781	30.000	37.587	62146.860	62691.860	17.414	250.38	0.117	0.015					
1065.835	30.001	37.586	63950.100	64495.100	17.915	253.96	0.116	0.015					
1095.857	30.000	37.586	65751.420	66296.420	18.416	257.48	0.115	0.015					
1125.863	30.000	37.586	67551.780	68096.780	18.916	260.95	0.113	0.014					

Formulae Used for Analysis of Data

Uppercase letters refer to columns

Lowercase n refers to row, beginning with n=4

Dn = (An * 60)

En = (Dn + M4)

Fn = (En / 3600)

Gn = SQRT (En)

Hn = (((Cn - L4) / L4) * 100)

In = ((J4 - L4) / (J4 - L4))

K4 = (((J4 - L4) / L4) * 100)

N16 = (((N12 - N8) / N8) * 100)

Source binary TA data file : pib0137d.01

14 lines in the parameter block

3 channels of data

Run 40

Module TGA Aluminum Pans

Sample PIB40 Glove SCO2 0137D Disk .25"

Size 39.176 mg

Method DESORPTION-Isothermal

Operator bsl

Comment .263"x.039",HP@1400x50,Dry;DS-37.6 M-37.44 TG-37.543 ET: 9:05

Nsig 3

Sig1 Time (min)

Sig2 Temperature (eC)

Sig3 Weight (mg)

Kcell 1.0000

Date 16-May-00

Time 11:49

Blank

FIGURE . CHEMICAL-MATERIAL INTERACTION DATA SET:**Supercritical Carbon Dioxide and Polystyrene-butadiene****PSB****Sorption, Desorption Diffusion, and Indentation Data Sets****Material Data**

Test Reference Number:	<u>13-1-1</u>	TGA Filename:	<u>psb0140d</u>
Property Test Specification:	ASTM D471/D543		
Material Name:	<u>Polystyrene-butadiene</u>	Material Code:	<u>PSB</u>
Material Supplier:	<u>The Resinkit Company</u>	Material Class:	<u>TP</u>
Monomer Source:	<u>Resin Kit #8</u>	Base Polymer (Lot. No.):	<u>Unknown</u>
Exposure Liquid:	<u>Supercritical Carbon Dioxide</u>	Replicate Number:	<u>1</u>

Pre-Exposure Data

Measured Diameter (mm):	<u>9.84</u>	<u>9.74</u>	<u>9.76</u>	<u>9.85</u>	
Mean Diameter:	<u>9.800</u>				
Measured Thickness (mils):	<u>74.70</u>	<u>74.70</u>	<u>76.20</u>	<u>74.50</u>	
Mean Thickness:	<u>75.025</u>				
Initial Sample Weight (mg):	<u>142.020</u>				
Initial Durometer Hardness:	<u>63.6</u>	Scale: SHORE	<u>D</u>		
					95% Confidence Level (CL): <u>0.088</u>
					95% Confidence Level (CL): <u>1.255</u>

Sample Exposure Data

Exposure Date:	<u>05/19/00</u>	Time:	<u>11:23:00</u>	
Removal Date:	<u>05/19/00</u>	Time:	<u>11:38:00</u>	
Total Exposure Time (h:m:s):	<u>00:15:00</u>	Weight of Sample After Exposure (mg):	<u>148.70</u>	
Weight Gain (mg):	<u>6.68</u>	Percent Weight Gain:	<u>4.70</u>	
Final Durometer Hardness After Desorption:	<u>45.8</u>	Percent Hardness Change:	<u>-28.0</u>	

Desorption Experiment

Mean Temperature of Desorption Experiment (setpoint = 30 deg C):	<u>30.001</u>	95% CL:	<u>0.0004</u>
Time Lapse Between Sample Exposure and Sample Desorption (sec):			<u>610</u>
Equilibrium Weight of Desorbed Sample at 30 deg C (mg):			<u>142.000</u>
Sample Extracted (mg):	<u>0.02</u>	Solubility Corrected for Extractables (mg):	<u>6.70</u>
Sample Extracted (%):	<u>0.01</u>	Solubility Corrected for Extractables (%):	<u>4.72</u>

Diffusion Coefficient Data: Fick's Law

High Concentration Diffusion Coefficient (cm ² /sec):	<u>9.7266E-07</u>
Range Including 0,1 Intercept, Relative Weight Fraction:	<u>1.00 - 0.54</u>
Linear Range of Desorption, Relative Weight Fraction:	<u>0.67 - 0.54</u>
Slope:	<u>-1.1680E-02</u>
X-axis Intercept:	<u>8.5039E+01</u>
R Square:	<u>0.99872</u>
Y-axis Intercept:	<u>9.9321E-01</u>

Low Concentration Diffusion Coefficient (cm ² /sec):	<u>1.4751E-10</u>
Linear Range of Desorption, Relative Weight Fraction:	<u>0.02 - 0.00</u>
Slope:	<u>-1.4383E-04</u>
X-axis Intercept:	<u>2.9524E+02</u>
R Square:	<u>0.82883</u>
Y-axis Intercept:	<u>4.2465E-02</u>

Wt. @ Zero Time, mg K 148.70	Wt. @ Zero Time, % L 4.704	Adjustment to TGA Time, sec M 610	Hardness Shore Scale N D
TGA Dry Wt., mg 142.020	Equil. Wt. Of Desorb. Sample 142.00	Min. Wt. Used For FDC, mg. 142.000	Pre Exposure Hardness 63.6
High Conc. DC, cm2/sec 9.7266E-07	Low Conc. DC, cm2/sec 1.4751E-10	Total Liquid Sorbed, mg. 6.680	Post Desorption Hardness 45.8
R Square 0.99872	R Square 0.82883		Change in Hardness, % -28.0
X Intercept 85.04	X Intercept 295.2		Mean Thickness, cm. 0.1906
Y Intercept 0.99321	Y Intercept 0.04247		
Y Intercept as Wt., mg. 147.691	X Intercept as Time, hrs. 24.2	X Intercept as Time, min. 145.3	psb0140d X Intercept as Time, days 1.0

TEMPERATURE STATISTICS

<i>Column1</i>		Max. TGA Wt., (orig data file) 146.740	TGA Wt. At 20 min. Adjustment 145.935
Mean	30.0009317	Sorption @ 7-12 min., mg	Sorption @ 20 min., mg
Standard Error	0.000200313	4.72	3.91
Median	30		
Mode	30	Sorption @ 7-12	Sorption @ 20
Standard Deviation	0.011080771	min., %	min., %
Sample Variance	0.000122783	3.32	2.76
Kurtosis	266.4820057		
Skewness	15.10275641	Rel. Error (%) of	Rel. Error (%) of
Range	0.281	7-12 min. Sorp.	20 min. Sorp
Minimum	29.943	-29.3	-41.4
Maximum	30.224		
Sum	91802.851		
Count	3060		
Confidence Level(95.0%)	0.000392762		

DIAMETER STATISTICS

<i>Column1</i>	
Mean	9.7975
Standard Error	0.02780138
Median	9.8
Mode	#N/A
Standard Deviation	0.05560276
Sample Variance	0.00309167
Kurtosis	-5.2112089
Skewness	-0.0828945
Range	0.11
Minimum	9.74
Maximum	9.85
Sum	39.19
Count	4
Confidence Level(95.0%)	0.08847648

ND/value
ND/value
A/D

THICKNESS STATISTICS

<i>Column1</i>	
Mean	75.025
Standard Error	0.39449335
Median	74.7
Mode	74.7
Standard Deviation	0.78898669
Sample Variance	0.6225
Kurtosis	3.74193965
Skewness	1.91237109
Range	1.7
Minimum	74.5
Maximum	76.2
Sum	300.1
Count	4
Confidence Level(95.0%)	1.25545507

Unknown
psb0140d

HIGH CONCENTRATION DIFFUSION COEFFICIENT

psb0140d

SUMMARY OUTPUT

<i>Regression Statistics</i>	
Multiple R	0.999359786
R Square	0.998719982
Adjusted R Square	0.998672574
Standard Error	0.003081805
Observations	29

ANOVA

	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	1	0.200079147	0.200079147	21066.4595	1.34869E-40
Residual	27	0.000256433	9.49752E-06		
Total	28	0.20033558			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>
Intercept	0.993213175	0.002687177	369.6121544	1.4976E-51	0.987699547	0.998726802
X Variable 1	-0.011679524	8.04691E-05	-145.1428934	1.3487E-40	-0.011844633	-0.011514415

LOW CONCENTRATION DIFFUSION COEFFICIENT

SUMMARY OUTPUT

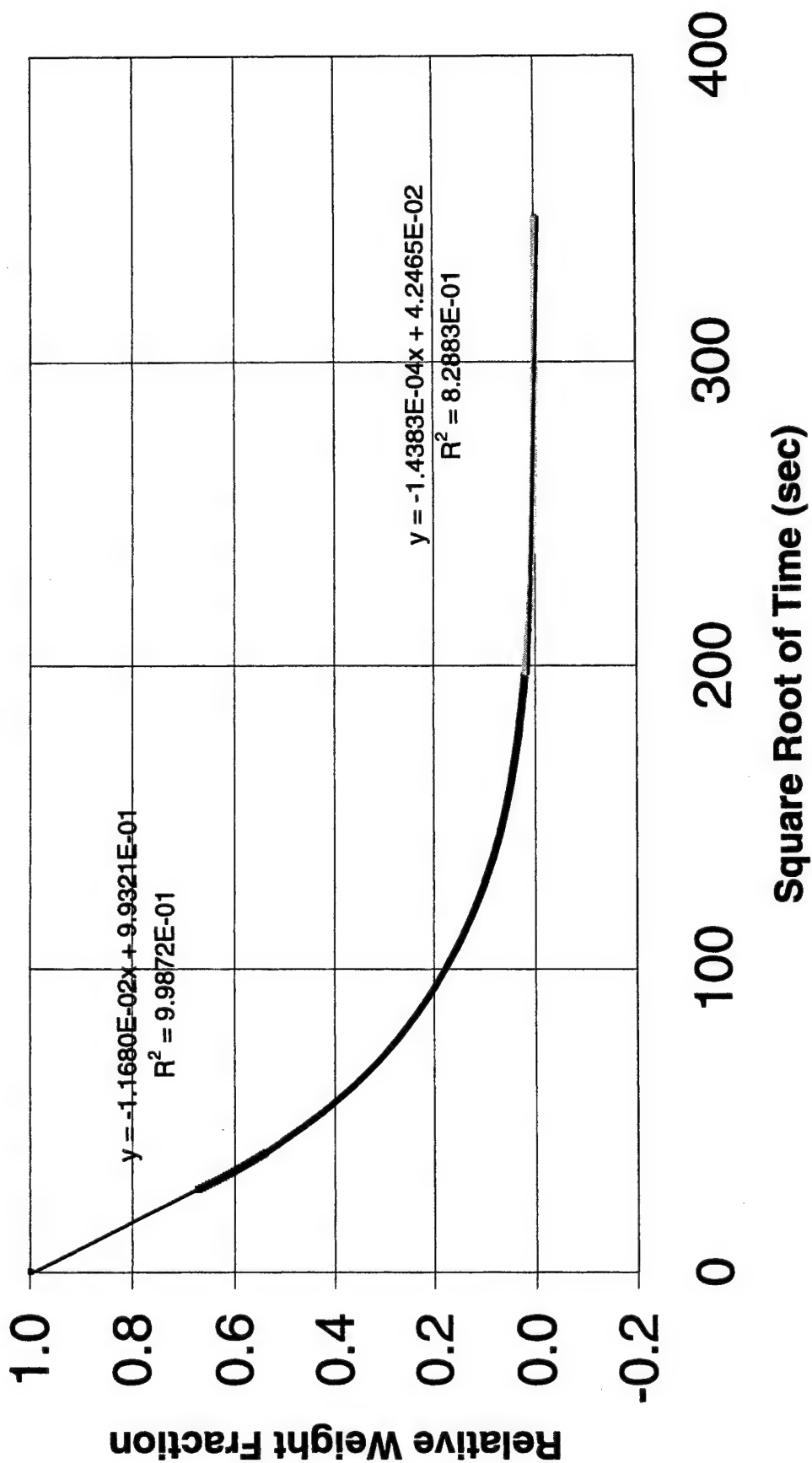
<i>Regression Statistics</i>	
Multiple R	0.910403271
R Square	0.828834116
Adjusted R Square	0.828738332
Standard Error	0.002281732
Observations	1789

ANOVA

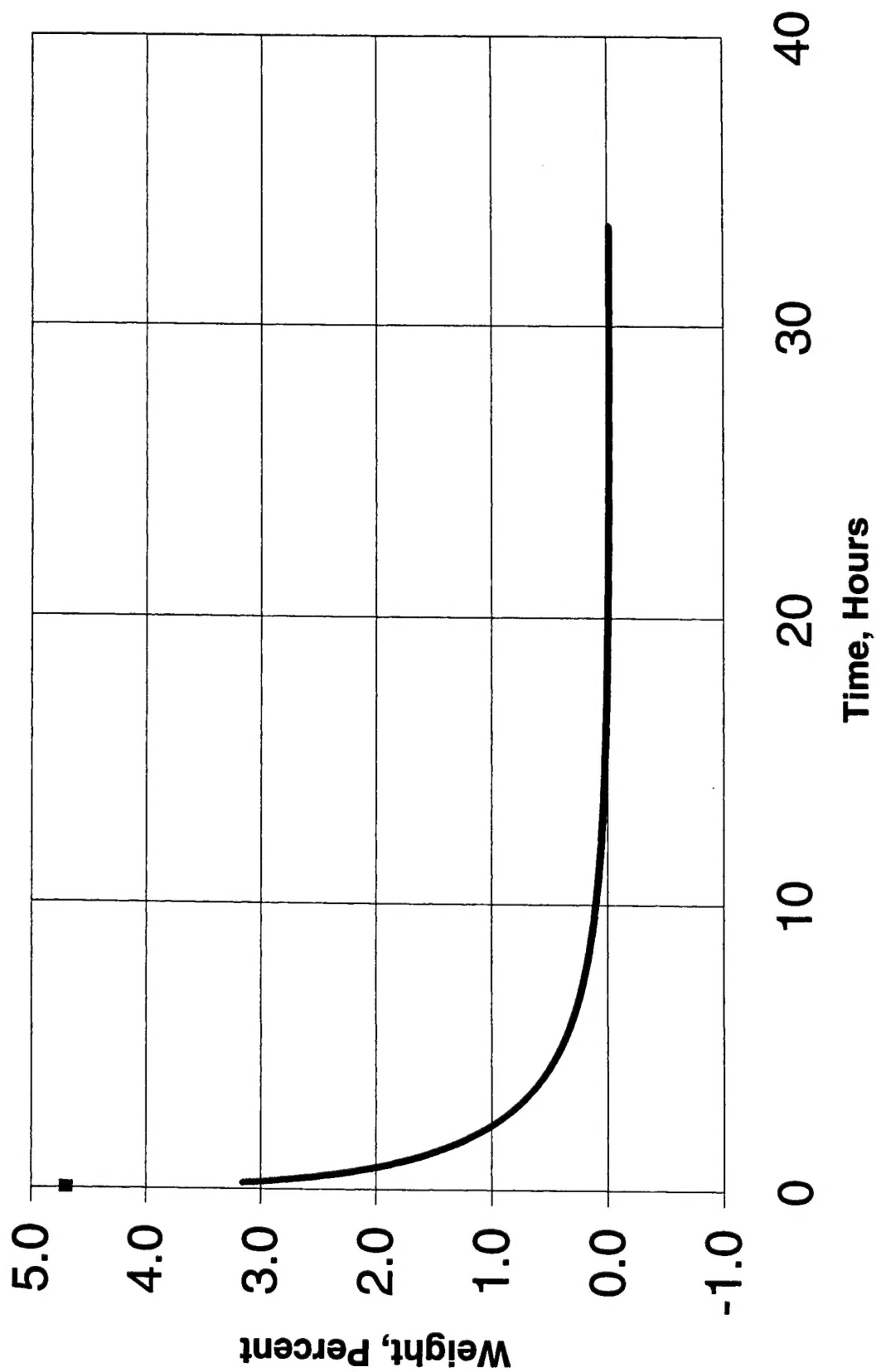
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	1	0.045050986	0.045050986	8653.16461	0
Residual	1787	0.009303661	5.2063E-06		
Total	1788	0.054354647			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>
Intercept	0.04246542	0.000400887	105.9286262	0	0.041679163	0.043251677
X Variable 1	-0.000143832	1.54621E-06	-93.02238766	0	-0.000146864	-0.000140799

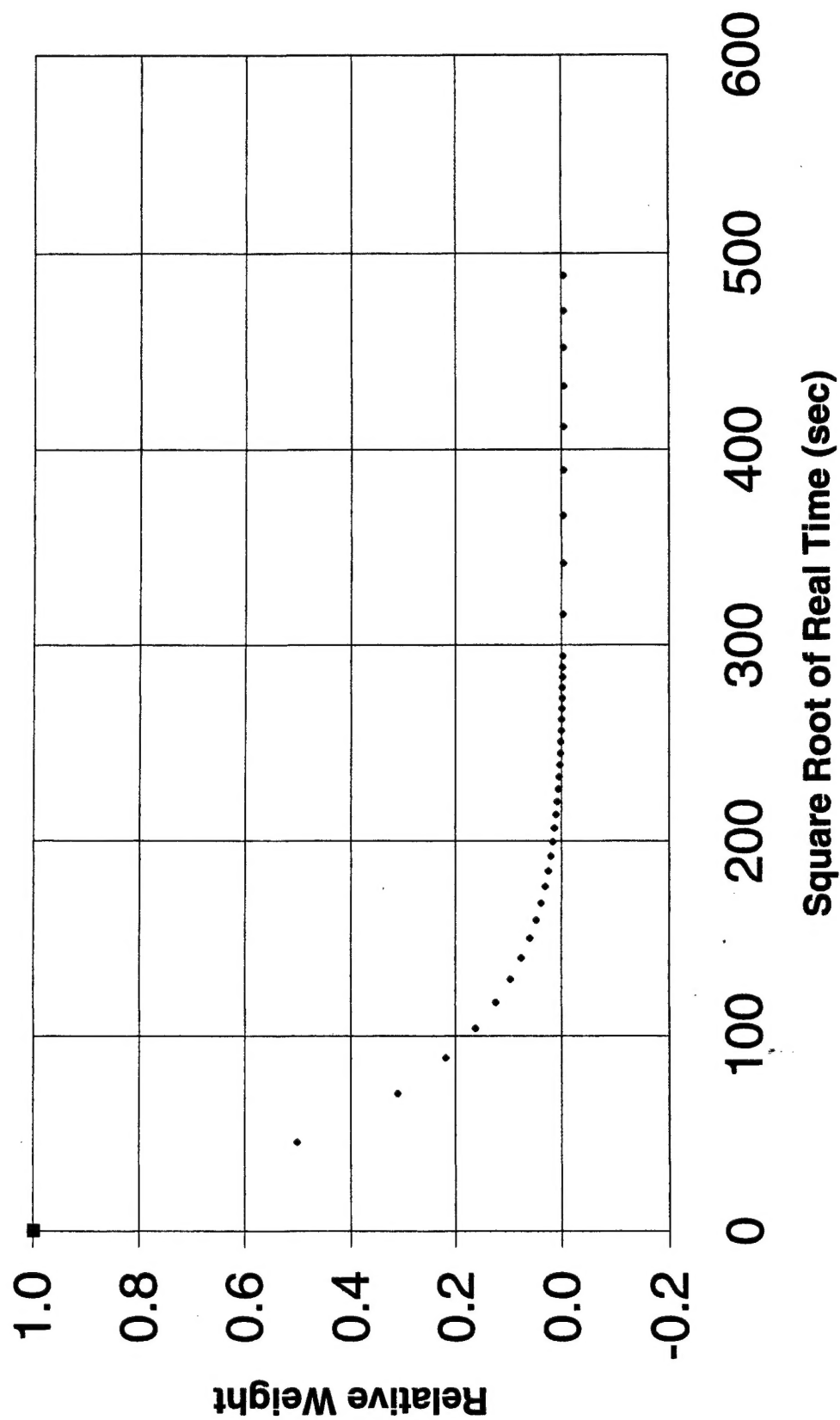
**Figure . Fick's Law Plot of Desorption Diffusion (30 degrees C)
of Supercritical Carbon Dioxide from Polymeric Materials:
PSB (0140d)**



**Figure . Desorption Diffusion (30 degrees C) of Supercritical
Carbon Dioxide from Polymeric Materials: PSB (0140d)**



**Figure . Fick's Law Plot of Desorption Diffusion (30 degrees C) of
Supercritical Carbon Dioxide from Polymeric Materials:
PSB (0140d)**



**Figure . Desorption Diffusion (30 degrees C) of Supercritical
Carbon Dioxide from Polymeric Materials: PSB (0140d)**

